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COLONIZATION AND IRRIGATION IN THE EAST AFRICA PROTECTORATE.*

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The British Empire possesses in the East Africa Protectorate a dependency of which the value and advantages are at present but little known. The protectorate has been described as the America of India, since it offers opportunities for colonization by the natives of that country. It has a coast-line some 400 miles in length on the Indian ocean, lying between Italian East Africa and German East Africa, and extending from the equator to about the fifth degree of southern latitude. The boundary on the south-west is the Anglo-German frontier, which is, more or less, a straight line extending from the coast at Vanga to the point on Lake Victoria Nyanza where 1° of southern latitude cuts the east coast of the lake. To the west lies a portion of the coast of Lake Victoria Nyanza and the Nzoia river, dividing the East Africa Protectorate from the British Protectorate of Uganda. This boundary has lately been altered so as to include, in the East Africa Protectorate, the country lying generally to the east of the lake. The northern boundary is still indefinite, and, owing to the vagueness of this boundary, the area of the East Africa Protectorate is also indefinite, but it may be roughly stated at about 280,000 square miles,† exclusive of the newly added tract, which is about 28,000 to 30,000 square miles in area. A material portion of this area, especially towards the north, is unexplored. The population of the original protectorate, excluding the newly added

* Read at the Royal Geographical Society, January 27, 1903. Map, p. 484.

† 'Précis of Information' concerning East Africa Protectorate, p. 26.

tract, is estimated at two and a half millions, but this figure is to a large extent conjectural, and nearly one-half of the population resides in the territory which is not under direct administration, and where the estimate of the numbers is a mere guess. The better-known parts of the East Africa Protectorate contain a very small * population to the square mile. Thus, in the province of Seyidieh the population is about seventeen persons to the square mile in an area of about 10,000 square miles; in Tanaland it is only about three to the square mile in a tract of some 34,000 square miles; Ukamba has the thickest population of any of the provinces into which the protectorate is divided, but there are only about twenty persons per square mile over some 53,000 square miles; while that part of the province of Jubaland which is explored has less than two persons to the square mile over about 17,000 square miles of country. The population of the newly added province is not known, but it is thin. The average population of the entire protectorate may be put down at about ten to twelve persons per square mile.

The traveller, passing through the heart of the East Africa Protectorate by the Uganda railway, cannot avoid noticing four important facts. First, the rich nature of the soil generally; secondly, the almost entire absence of cultivation; thirdly, the very small discharge in such streams or rivers as he may come across; and, lastly, the extreme paucity of the population. He will certainly see more zebra, antelope, and ostrich than human beings from the windows of the railway carriage.

The climate of the East Africa Protectorate varies, as might be expected, with the elevation of the lands above the sea. The country lies almost entirely within 4° north or south of the equator, and it is difficult to realize that in the very heart of the tropics a climate can be found which is so pleasant as that which actually exists in a considerable area of it. Near the coast the thermometer rarely falls below 70° Fahr., and it rarely rises above 90°; the monthly mean of the maximum temperatures in Mombasa in the coolest months (March and April) is about 89° or 90°, and the monthly mean of the minimum temperatures is about 70° or 71°. In these parts the climate is damp and enervating. But in the higher lands, say those which are 5000 feet or more above the sea, the climate is very different; the thermometer rarely rises above 80°, and often falls below 60°. The returns at Machakos and Fort Smith (5000 to 6000 feet above the sea) show that the monthly mean of the maximum temperatures is rarely more than 70°, although the actual maxima for short intervals are of course higher, and that the monthly mean of the minimum temperatures is rarely above 60°, and it falls at times as low as 50° or even 40°. This is the part of the country to

* Page 34 of 'Précis of Information.'

which reference will be made later, where the white man might live and flourish.

The rainfall, which is such an important factor as regards the agricultural prospects of the country, may be said to average about 40 inches in the year at the coast, and about 36 inches in the lands lying at a higher elevation than 5000 feet. On the banks of Victoria Nyanza, at a level of about 3700 feet above the sea, the rainfall is greater, and it averages from 50 to 70 inches in the year. The following statement is taken almost entirely from the *Report* of 1901 of the British Association for the Advancement of Science (p. 395):—

Year.	Coast.						Inland.				
	Kisimayu, 0° 22′ S. by 42° 3′ E.	Malindi, 3° 13′ S. by 40° 7′ E.	Lamu, 2° 16′ S. by 40° 5′ E.	Takaunga, 3° 41′ S. by 39° 5′ E.	Mombasa, 4° 4′ S. by 39° 4′ E.	Chugu and (Wanga) Shimoni, 4° 6′ S. by 39° 3′ E.	Kibwezi, 2° 25′ S. by 37° 5′ E.	Machako's, 1° 31′ S. by 37° 2′ E.	Fort Smith (Kikuyu), 1° 14′ S. by 36° 4′ E.	Munia's Kavirondo, 0° 29′ N. by 34° 3′ E.	Nairobi
1890 ...	—	—	29·0	—	34·7	—	—	—	—	—	—
1891 ...	—	42·0	—	—	46·6	—	—	—	—	—	—
1892 ...	—	30·1	—	32·1	26·4	—	—	—	—	—	—
1893 ...	—	50·8	44·5	40·7	64·2	66·3	—	—	53·0	—	—
1894 ...	13·7	28·9	21·1	38·0	38·0	42·0	26·7	42·0	48·1	—	—
1895 ...	—	34·9	—	35·7	34·3	38·5	33·1	—	65·0	—	—
1896 ...	19·5	53·6	41·3	47·8	65·2	56·6	21·7	25·9	29·5	58·8	—
1897 ...	19·9	58·0	32·3	54·4	52·6	56·7	21·5	31·7	36·3	93·5	—
1898 ...	10·9	14·4	12·4	24·0	25·0	27·3	—	24·3	36·2	69·1	—
1899 ...	12·4	33·4	22·0	33·1	35·2	52·5	—	21·8	—	—	—
1900 ...	12·9	37·0	—	58·1	61·7	59·8	—	58·3	—	50·0	42·4
1901 ...	—	—	—	—	—	—	—	—	—	—	38·8
Average	14·9	38·3	28·9	40·4	44·0	50·0	25·7	34·0	44·6	67·8	40·6

The monthly rainfall statistics of the places included in the above table show that near the coast the south-west monsoon causes heavy rain in April and May, some 20 to 30 inches falling usually during these months; light falls occur from June to October, and in November the fall is generally heavier; December to March are dry months. In the higher land, above 5000 feet, the heaviest falls are usually in March, April, and May; a dry season follows from June to October, when there is usually a second period of rain in November or December.

Falls of more than 5 inches in twenty-four hours appear to occur very rarely; falls of more than 4 inches are not frequent. The records which exist are about to be supplemented by the institution of rainfall stations along the railway at intervals of about 40 miles; it seems most desirable that the meteorological observations of the protectorate should be digested and tabulated on some authorized system; at present the

records are not kept in a uniform manner, and are not readily accessible. They are most important.

The agricultural possibilities of the East Africa Protectorate are not as yet well known. Cocoanuts, mangoes, oranges, lemons, pineapples, plantains, flourish near the coast. Maize, rice, sweet potatoes, are cultivated to some extent. In the interior millets, sweet potatoes, and Indian corn are the chief crops; these are grown without irrigation, but often in a more or less uncertain manner, and the crop is said to be not only uncertain, but in most cases very light. Large quantities of rice, flour, and grain are imported at Mombasa; the Indian workmen who have constructed the Uganda railway have been mostly fed on imported grain. The soil in the higher lands consist largely of that commonly called "black cotton" soil, but there is also a red soil over a considerable portion of the uplands, which is said to be even more fertile than the black one. The higher lands are, to a large extent, volcanic, and there are steaming springs on the west side of the Great Rift-valley.

Throughout the district traversed by the railway it is universally said that crops suitable to the various elevations could be grown at almost any place with irrigation. There seems to be little doubt that this is a fact. It does not, however, appear to have been established that irrigation is, in all cases, essential. It is a fact that in some parts, more particularly in the higher lands, crops of potatoes, onions, wheat, barley, etc., are grown without irrigation: but the outturn is very far below that of irrigated crops. It seems quite possible that, when the seasons have been more fully investigated and the proper periods for planting particular crops are better known, suitable crops may, in years of normal rainfall, be successfully cultivated on a large scale without irrigation. But it cannot be asserted that this is a fact. It may be that, although the temperature and rainfall appear suitable for certain crops which are not at present grown, the evaporation and absorption may, under the influence of the tropical sun, be too great for them. It would seem most desirable that experiments should be made to determine this point.

There can, on the other hand, be no doubt that, with irrigation, the agricultural prospects are favourable. This is shown by the fact that at almost every railway station where there is any spare water available from the engine-tanks, the Indian workmen make little gardens in which vegetables grow luxuriantly. The guard of one ballast train had mint, chillies, potatoes, and radishes growing well, but he said they needed frequent waterings, or the plants were scorched up by the strong sun and rich soil. In the settlement of Nairobi, where the staff of the railway is established, all English vegetables can, with irrigation, be grown at all seasons. Peas, cabbages, lettuces, and potatoes can be had at any time of the year. Potatoes, which are now mainly supplied from France, have done particularly well, and it seems possible that the trade

BETWEEN GILGIL AND EBURRU.

in them may extend to the ports on the East Coast of Africa. The manager of the Uganda railway has arranged a through rate for potatoes with the B.I.S.N. Companies' steamers, and specimen consignments have been sent to the south, and even to Durban and Natal. The vast rolling plains of grass, in which the zebra and antelope now find abundant pasturage, might, there seems little reason to doubt, be turned into sheets of wheat, oats, and other cereals, possibly without, but certainly with irrigation, where that is possible. These plains lie in the temperate tracts where Europeans can live in fair comfort, and if they will, they might, to some extent at any rate, labour with their own hands. The climate and soil in these parts seem suited for European fruits and vines, and it is most probable that the few available sources of irrigation would be most advantageously employed in their cultivation.

The Uganda railway, which is now practically completed, is a magnificent monument to the skill, perseverance, and energy of the engineers who have designed and constructed it. The railway rises from the level of the sea at Mombasa, with a maximum gradient of 2 feet in 100, to a height of 8320 feet above the sea, and then it drops again to 3770 feet at the shores of Lake Victoria Nyanza. Throughout its length of 584 miles from the sea to the lake the railway is rarely on the flat, and its course is rarely in a straight line. It is almost always twisting and winding among the hills, and, at the same time,

either raising itself on gradients, often as steep as 1 in 50, over some eminence, or dropping into a valley at the same rate of descent. At the Kikuyu escarpment the lines wind down some 1400 feet, by a series of skilfully designed benches in the hillside, into the Great Rift-valley; then on the further side of that wonderful depression they rise more than 2000 feet again, up the steep slopes of the Mau escarpment. In its course the railway passes through tracts of country which vary almost as much as the plains of the valley of the Ganges vary from the highlands of Scotland. Some 40 miles from the coast the pitiless Taru wilderness, which has absorbed so many human lives, stretches for a length of some 60 or 70 miles, and in that length the rails are raised from 600 to 1800 feet above the sea. The wilderness is covered with scrub jungle, and the soil is said to be productive; but it is waterless and almost devoid of any form of life. In parts the railway has pushed its way through thick forests, mostly in black loamy soil of considerable depth; in others it rises and falls over rolling grassy plains of vast extent, which are thick with game feeding on the luxuriant pasture.

It will be readily understood that the engineers had no small physical difficulties to contend with in such a country. It had from the first been determined that the railway should be so constructed that the trains should always proceed with the engines in front of them, and that "reverses" should not be allowed on the permanent line. If they had been permitted, it would have been comparatively easy to

BETWEEN RAILWAY AND SNOWDON'S CAMP.

CARANDU VALLEY AND LAKE ELMENTEITA.

have climbed, by a series of zigzags, up and down the steep hillsides. But this would have involved the dangers, which are inseparable from such a system, under which a broken coupling might, and probably would, wreck a train; or an inexperienced or careless driver might easily overrun the dead end of a "reverse," and either launch his train over a precipice or drive it into a cliff. An alignment had to be sought out, often in thick jungle, on which rails could be carried straight ahead with a maximum gradient of 1 foot fall or rise in every 50 feet of length; numerous trial lines had to be run and experimental drifts cut through the jungle to determine the right course to pursue. The result must be pronounced a masterpiece in engineering skill. It must not, moreover, be forgotten that the engineering difficulties were not the only ones which had to be overcome. The natives of the country were few in number, unskilled, and, with very few exceptions, quite unwilling to work; consequently nearly the whole of the labour force was obtained from India. In many parts there was little or no water, and absolutely no food for the workmen; special arrangements were consequently necessary to carry water by the railway itself, as it was made, and to import and deliver grain for the workmen at the points where work was progressing. In parts wild animals were a serious source of danger, and special arrangements had to be made, which were not always successful, for the protection of the workmen from lions.

The Uganda railway, in addition to the political effects of its

construction, must have, and indeed already has had, a marked effect on the habits and mode of life of the natives. It has brought them into immediate contact with civilization, and opened up possibilities of trade. It has calmed inter-tribal animosities, and checked the feudatory raids of the aggressive races. It has opened up the whole of the countries lying near the coast-line of the Victoria Nyanza lake to comparatively easy communication with the sea and with Europe.

Lake Victoria Nyanza is about half the size of England. The surveys of it are most imperfect as yet, and the shores are but partially explored. There is a survey of the northern part, which shows the coast-line and the islands lying between Fort Florence and Entebbe, the capital of the Uganda Protectorate. A small steamer, which was laboriously carried up partly by rail, partly by cart, but mainly by porters from the coast, runs between those two places, but it will shortly be supplemented by two much larger ones, which the Uganda Railway Administration is now constructing on the shores of the lake, to navigate it, and to carry to the railway terminus at Port Florence the trade which the country bordering on the lake may supply. The survey which has been made shows that, in addition to the many visible islands which are dispersed over the northern portion of the lake, and which are in themselves dangerous to navigation by night, there are hidden dangers in the shape of rocks which lie below the surface. The new steamers which will shortly float on Nyanza will need to proceed with great caution when venturing into unexplored waters, and a

PORT ALICE, VICTORIA NYANZA.

detailed survey is being made by Commander Whitehouse. It is at present impossible to tell where a sunken and invisible rock may not lie beneath the surface. This danger is increased by the fact that the level of the water in the lake varies from month to month and from year to year, so that a sunken rock which may at one time be at a safe distance under water, would at another time wreck a boat which happened to pass over it. It would be a work of some difficulty to find and demarcate these rocks.

The fluctuating level of Victoria Nyanza is a matter of great interest, both to engineers who may regard the lake as a vast reservoir from which the summer supply of the Nile might possibly be increased, and to students of physical geography. Since 1896, records of the level

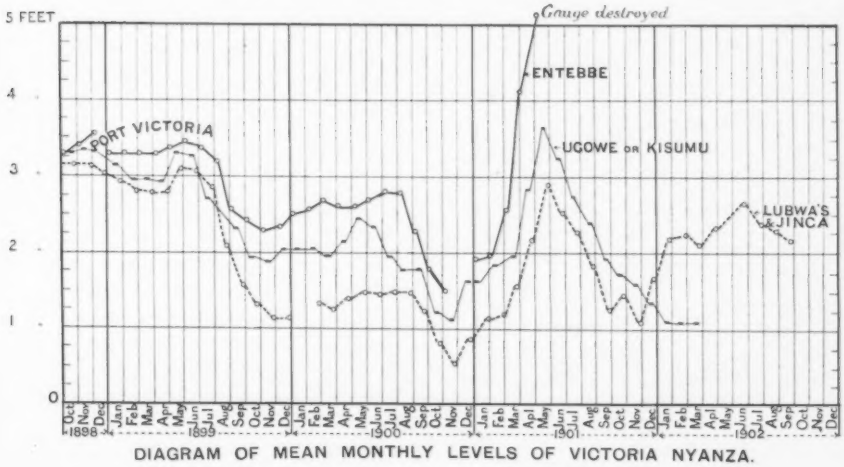


DIAGRAM OF MEAN MONTHLY LEVELS OF VICTORIA NYANZA.

of the surface of the lake have been kept at several places in the northern part of it, but these records have to be studied with care and accepted with much caution, or erroneous deductions may readily be drawn. The lake-levels which are in the Appendix * are tabulated by months only, but the readings have generally been recorded daily, as shown in the last table. During the years 1896, 1897, and until October, 1898, the three gauges at Port Alice or Entebbe in Uganda, at Port Victoria, on the Berkeley gulf in the north-east corner of the lake, and at Lubwa's near the outlet of the Victoria Nile, must be read only as recording the fluctuations in level at those places; the zeros of the three gauges were not supposed to be at the same level, nor

* I am indebted to Major (now Sir Robert) Hanbury Brown, C.M.G., Cairo, for these figures.

was the reduced level of them known. But in October, 1898,* the zeros of the gauges are said to have been adjusted to the same level, and the readings appear to show that this was really done, or, at any rate, it was approximately done. This is shown by the fact that there was very little variation in the level of the lake during that month at any of the three stations, as the "average" reading was 3 feet 3 inches at Port Alice; 3 feet 3½ inches at Port Victoria; and 3 feet 1½ inch at Lubwa's: the variation between the maximum and minimum readings of the whole month was only 1¾ inch at Port Alice, 3½ inches at Port Victoria, and 2½ inches at Lubwa's. These figures seem to prove that at that time the zeros of the gauges must have been at the same reduced level, or, at any rate, within 1 or 2 inches of it. The

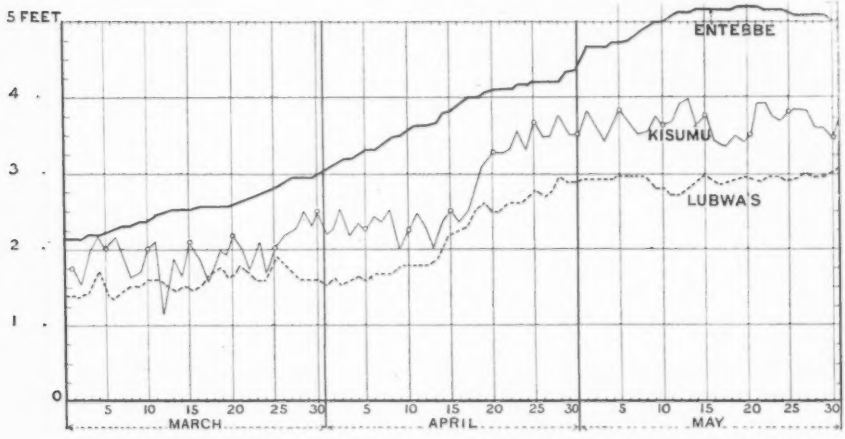


DIAGRAM OF DAILY LEVELS OF VICTORIA NYANZA, 1901.

subsequent readings, however, show divergences, which it is certainly difficult and apparently impossible to reconcile.

The gauges at Entebbe and Lubwa's, at any rate, were fixed in October, 1898, at practically the same level; yet in December, 1899, when the lake only varied 2½ inches in level, the Lubwa's gauge read 14 inches lower than the Entebbe one: in July, 1900, it was 15 inches lower, and in May, 1901, it was 27 inches lower. The last table in the Appendix shows the daily readings at three places. These are plotted in the following diagram:—

It will be seen that from March 1 to May 15, 1901, the Entebbe gauge rose 3 feet, the Kisumu gauge rose 2 feet, and the Lubwa's gauge 1 foot 7 inches. It seems impossible that these figures can be correct.

* Page 393, Report of the British Association for the Advancement of Science, 1901.

It has been suggested that the lake-level is affected by the wind. This is undoubtedly the case at Kisumu, where the gauge regularly rises and falls with the wind, and it is no doubt so, to some extent, on all places on the lake. But though the wind causes fluctuation in level, its effects cannot continue to influence the gauges steadily for long periods; during the first three days in March and about May 15 the gauges were steady, and it seems incredible that the general level of the water surface could have risen 17 inches more at one place than at another. Lubwa's is only 70 or 80 miles from Entebbe as the crow flies, and both places are on the body of the lake. It seems impossible to reconcile these discrepancies; it would appear that either the readings must be wrong, or the level of the zeros must have been changed, or the gauges must be so placed that they do not record the true level of the lake. It is greatly to be regretted that these discrepancies occur, as they throw much doubt on the records. It is most desirable that a really reliable bench-mark should be made in the neighbourhood of each gauge, and that the level of the zero should be tested from time to time. This has not been done. The Entebbe gauge was moved in 1901 to a better site, and there was a hiatus of some months in the readings. The new gauge and the old one were not connected by levelling, nor was the zero of either referred to any permanent bench-mark, so the connection between the new and old readings is lost. The local officers who deal with the gauges are busy men, and have but little time to devote to this subject. They also, perhaps, fail to appreciate the importance, so apparent to an engineer, of preserving an absolutely accurate record of the level of the datum of the gauges.

The catchment area of the lake, as taken from the maps, is about 95,000 to 100,000 square miles, including the lake itself, which is about 26,000 square miles; but the surveys, both of the lake and the surrounding countries, are, of course, imperfect. Many rivers and streams flow into the lake, but the only outlet is the Nile at the Ripon falls near Jinja. The rainfall returns show that in the northern portion of the lake the annual rainfall is from 40 to 70 inches; but over 90 inches was recorded at Mumia's in 1897. The rainfall is probably less in the southern parts, and it is generally assumed (on very imperfect data, however) that the ordinary rainfall over the catchment is about 30 inches. It is interesting to note what a small proportion of this water passes over the only escape from the lake at the Ripon falls. These falls may possibly draw off from the lake sufficient water to lower it 9 inches or a foot in the year, but evaporation and absorption must be at least six or eight times as much as this.

The Ripon falls would be better described as rapids. There is a rocky barrier of hornblende schist, like an embankment, across the channel where the Nile issues from the lake. This barrier is perhaps 10 to 12 feet above the ordinary lake-level, and would, if it were

continuous, completely close the outlet. But it is broken in three places by gaps in the barrier, and the water rushes through these like the discharge from the under-sluices of a weir. The barrier, from shore to shore, is perhaps 1200 feet long, and the three gaps in it are probably less than 300 feet, but they have never been measured. The water of the lake above the barrier is about 14 to 15 feet above that in the river below. The depth of water in the breaches through which it rushes has never been ascertained, but it probably does not average more than 6 to 8 feet; it is certainly less in places, as the rocks can be seen below the water. The discharge over the falls varies with the level of the lake.* Mr. Willcocks gives the minimum discharge of the Ripon falls as 25,000 cubic feet per second,

RIPON FALLS.

and the maximum as 30,000 cubic feet; but there seems reason to think that the minimum discharge may fall as low as 15,000 cubic feet per second. But even 30,000 cubic feet per second would only draw $\frac{1}{25}$ part of an inch off the entire surface of the lake in one day, or about 1¼ inch in a month. The lake rarely falls quickly; the most rapid fall shown by the gauge-readings was in October, 1900, when a fall of 10 inches in eight days is recorded at Port Ugowe, but this is not corroborated by the other gauges, and must be received with doubt. The Lubwa's gauge in August, 1899, fell 1 foot in a month, and 11 inches in sixteen days; the Entebbe gauge, however, only fell 6 inches in the same month. To lower the lake 6 inches in a month would

* 'The Nile Reservoir Dam at Assuan,' p. 13.

require a constant discharge of 150,000 cubic feet per second, or five times the probable maximum discharge of the falls; to lower it 11 inches in sixteen days would need about 500,000 cubic feet per second for that time; to lower it 10 inches in eight days would require a discharge of nearly a million cubic feet per second, or about thirty times the probable discharge of the Ripon falls. It seems clear, then, that, in any case, the discharge from the Ripon falls is only a small factor in the matter. It is evaporation from the surface which is the main cause of a drop in the lake-levels. A fall of 6 inches in a month seems to be a high rate of fall for the lake generally; as the Ripon falls only take off a little more than one inch as a maximum, it follows that a high rate for evaporation and absorption would be 5 inches in a month on the supposition that there was no rainfall; but there would always be some rainfall and some flow off the catchment, probably aggregating 2 inches at least. So the *maximum* evaporation and absorption is probably not greater than 7 or 8 inches in a month, or say $\frac{1}{4}$ inch to $\frac{1}{3}$ inch a day. On the other hand, if the Lubwa's gauge is correct, and the lake really did drop 11 inches in sixteen days, it follows that the maximum loss from evaporation and absorption must be much greater. For in the sixteen days the falls would take off less than one inch from the surface of the lake, so the loss from other causes must have been more than 10 inches, or more than $\frac{5}{8}$ of an inch a day. This is highly improbable.

The maximum rise which is recorded in the lake was in 1901, when it was almost 10 inches in fifteen days. This rise may be reasonably explained as follows.

The catchment area, beyond the limits of the lake itself, is approximately three times the area of the lake. So that, if half the rainfall on this catchment flowed into the lake in any given time, the level of the lake would be raised (were there no loss) by (1) the depth of rainfall on the lake plus (2) one and a half times the depth of rainfall on the catchment beyond the lake. So a fall of 6 inches over the whole catchment in fifteen days (were there no loss) would raise the lake (1) 6 inches plus (2) 9 inches, or 15 inches in all. During the time the loss due to the Ripon falls would be about half an inch, and the evaporation and absorption might account for about $4\frac{1}{2}$ inches. So, on this hypothesis, the net rise in the lake would be 10 inches in fifteen days. The calculation depends, of course, on two main assumptions: first, that the flow off the catchment is half the rainfall; and, secondly, that a fall of 6 inches in fifteen days might occur over the entire catchment.

The available data are quite insufficient to prove whether these assumptions are correct; all that can be said is experience elsewhere shows that they are not unreasonable.

All these considerations point clearly to the conclusion that the rise and fall of the lake is mainly—almost entirely—due to climatic

considerations, and is but little affected by the draught of the Nile at the Ripon falls. Engineers who calculate on the lake as a vast storage reservoir for irrigation would do well to remember that the converse of this is true—that is, that no works they can construct will enable them to control anything but a very small percentage of the rainfall on the catchment of 100,000 square miles. Nature, not man, rules over at least nine-tenths of that rainfall; it is incessantly either falling from the skies or being drawn up to them again. It is only the residue escaping at the Ripon falls which man can deal with. This is comparatively a small amount, not greater than the *maximum* discharge of one of the great canals in Egypt.

About halfway between the coast and the great lake the Uganda railway reaches an elevation of 5000 feet above the sea, and for 250 miles or more never drops below that elevation. In this part there is a country not less than 5000, nor more than 10,000,* feet above the sea, which is rich, temperate, and in parts beautiful. It is hard to conceive that such a tract can exist in the heart of Africa, within a few miles of the equator. There are forests in parts, open plains in parts, park-like lands in parts covered with rich grass and dotted here and there with trees. This tract of country, which extends over an area of some ten or twelve thousand square miles †—say the size of England north of Liverpool and Sheffield—is almost uninhabited at present, and it offers a field for colonization by Europeans, which, so far as climate, at any rate, is concerned, seems eminently suitable. The world in East Africa says that not only this tract, but the protectorate generally, only needs irrigation to be a magnificent agricultural country. This is, however, a statement which must be received with caution; it would certainly seem to be the case that the great grassy plains which extend for many miles on the Uganda railway need nothing but water to make them as productive as the valleys of the Ganges or the Nile. But the question of the irrigation of these plains is not an easy one; it is one which obviously needs consideration and discussion, and this paper is mainly written to discuss it.

Many people who talk of the necessity of irrigation seem often to forget the elementary fact that irrigation cannot be effected without water; they, too, have frequently not even the most vague idea of the volume of water necessary to mature a crop. Rivers are, of course, the most obvious source of supply, but the rivers, in the higher lands through which the Uganda railway passes, are too insignificant and uncertain in their discharge to irrigate any large tracts of country.

There are three main rivers in the protectorate: the Juba, the Tana, and the Sabaki. The Juba river forms, for a great portion of its course,

* Page 9 of Sir H. Johnston's Report (Africa, No. 7, 1901).
† Ibid.

the eastern boundary of the northern part of the British territory. It rises in the highlands of Abyssinia, and has a perennial discharge, which is small in the dry season, but is considerable during the two flood seasons. These occur from July to October, and again in March and April.* The Juba is navigable for about 400 miles from the sea. The Tana river rises from the snows of Mount Kenya, and in the highlands of the Kikuyu and Settim hills; it is said to be a considerable stream in its higher reaches, but to become materially reduced in volume before it reaches the sea. It is navigable for about 200 miles. The banks of this river, in its lower reaches, are cultivated † to a considerable extent, and the fields are irrigated by little canals cut from the river.

It seems probable that irrigation schemes of considerable magnitude might be possible from the Juba and the Tana, especially in the higher lands, but no reliable data are available as to the discharges of the streams or of the country which might be benefited.

The greatest interest, however, attaches to the Sabaki river and its tributaries, as they lie in the best known parts of the protectorate, in the neighbourhood of the Uganda railway where colonization, either by Europeans or by natives of India, seems not only possible, but desirable. The Sabaki river has two main tributaries, the Athi and the Tsavo. The former rises a little above Nairobi, in the Kikuyu hills, and flows in a south-easterly direction, more or less parallel with the railway, until its confluence with the Tsavo river. At Nairobi, one of the tributaries of the Athi river has a small perennial discharge, perhaps 30 cubic feet per second; but lower down, the Athi river for a great portion of the year is said to be only a series of pools, with little or no flow at all between them. The Athi is subject to occasional floods, but no data are available of their duration or volume. The Tsavo river rises in Mount Kilimanjaro, a beautiful snow-clad mountain over 19,000 feet high, which lies in German territory just beyond the boundary between British and German East Africa. It has a perennial discharge, which the engineers of the railway estimated to be about 380 cubic feet per second. There are no accurate gaugings of the river, and it is not improbable that the discharge may fall below this estimate, but, as the river is snow-fed, there must always be a considerable volume of water in it. It is the only river in this part of East Africa from which perennial irrigation, on anything but the smallest scale, is possible; the supply might be sufficient to irrigate from 30,000 to 40,000 acres of land, and it would probably be possible to get two crops a year from this area. The best plan, apparently, would be to throw a weir across the Sabaki river below its confluence with the Tsavo, and to distribute the waters of both rivers over the tract which was most easily

* Pages 27 and 28, 'Précis of Information' concerning the British East Africa Protectorate.

† Page 50 of 'Précis of Information.' 1901.

irrigable. The irrigated land would be at about an elevation of 1200 to 1400 feet above the sea, and should be suitable for sugar-cane, opium, and millet crops. The tract which would be irrigated lies within the field of action of the tsetse fly. This is a factor which must not be overlooked. It might prove difficult, or even impracticable, to cultivate where this pest holds sway.

It has been suggested that the great Tarn wilderness, which lies at an elevation varying from 600 to 1800 feet above the sea, might be irrigated, possibly from the Tsavo. This scheme does not seem feasible, and even if the waters of the river could be led on to the wilderness, the area which could be irrigated would only be a very small fraction of it.

In the tract of land which might be suitable for colonization by Europeans, lying at an elevation of more than 5000 feet above the sea, there are small hill streams. Some few of these have a small perennial discharge, but it is very small. In the 250 miles of railway which runs through these highlands there may be four or five streams, such as the Morendat, the Gilgil, and Niozo, of which the minimum discharge is 10 to 15 cubic feet per second. If this discharge were fully utilized, as it easily could be, two crops a year might be raised on a widely distributed area of say 10,000 to 12,000 acres. But what is this in a tract of 2000 or 3000 square miles? Already some small beginning has been made in irrigating lands from the small river at Nairobi (5400 feet). A little artificial channel some 8 feet broad has been made, and irrigation of potatoes and garden crops is effected. About 5 or 6 miles from Nairobi, also at the Riverside Farm, large crops of potatoes have been secured by irrigation, and all European garden produce has been successfully grown.

The hill streams, however, are not, of course, limited to their perennial discharge; they, and many others which have no perennial discharge at all, but run absolutely dry for a great portion of the year, have torrential discharges after periods of heavy rain. It would, no doubt, be possible to find among the hills many suitable sites for reservoirs in which a portion of the floods could be impounded, and this appears to be the only possible way in which any considerable area could be irrigated in the uplands of East Africa. It is doubtful whether, in places, the soil would be sufficiently retentive to hold the water, and the sites would have to be selected with care. It is improbable that these reservoirs could be on a large scale, but they would generally consist of earthen embankments across gorges, with probably a masonry escape for a by-pass. The reservoirs would be dotted about the country with probably two or three farms of a few hundred acres, each dependent on each reservoir. The reservoirs and supplementary works would vary greatly in cost according to circumstances, but this system of irrigation would be far more expensive than that of utilizing the small perennial discharge which is available in a few streams.

It has been suggested that artesian wells might produce a good supply of water. It is extremely probable that such wells would succeed in places. A boring was made in the Taru wilderness, but it was carried to a depth of 60 feet only, where it ended on granite rock and produced no water; it is now proposed to sink a well to a greater depth somewhere on the Kapiti plains. But such wells, even where they did produce water, would only give a moderate discharge; any extensive irrigation of crops from them would probably be financially impossible. But they would be invaluable on the great prairies of grass, where countless herds of cattle could be raised in luxury if water could be provided for them to drink throughout the dry season. It is improbable that these vast plains could ever be laid down in grain, as they might be if they could be irrigated, but there seems no reason why they should not be converted into farms for sheep, cattle, and poultry. The great flocks of the Masai tribe are evidence of this.

In Italy and in Baluchistan a system of irrigation is adopted which might be successful in some parts of East Africa. Tunnels are run into the hills, tapping underground streams, which are led out to the surface through the tunnels. The channels are called fontanelli in Italy, and karezes in Baluchistan; they are not difficult to construct when the circumstances are suitable and timber is cheap, but they require labour skilled in this particular kind of work, which would not be available in Africa.

It would appear, then, that the East Africa Protectorate is not, as far as can be seen from the information at present available, a country for grand irrigation projects. There may be places on the Tana and Juba rivers where large perennial canals are possible; but this is doubtful. It is a country which can be best developed, from an agricultural point of view, by utilizing to the utmost the natural rainfall, and by supplementing this by small storage works which would impound the fluctuating discharges of the streams. Such works must necessarily be scattered.

It has already been stated that the population in the East Africa Protectorate only averages about ten to twelve persons per square mile, and that there are parts of it, which are the most temperate and the most healthy, where there is hardly any population at all. There can be little doubt that, even without irrigation, the country could support a much greater number, and that, in those parts where irrigation is possible, three hundred or four hundred persons per square mile could flourish. The natives of the country are apathetic, and not given, as a rule, to agriculture. The colonization of the temperate highlands by Europeans or Eurasians, and of the lowlands by the natives of India, is a scheme which seems a promising one. It is by no means improbable that, if inducements were offered to the Indians who have constructed the Uganda railway, and if arrangements were made to

help them to bring their families to this country, a beginning might immediately be made. There are now almost eight thousand of these men in the protectorate, and among them there must be a percentage, probably a small percentage, who would remain, but they would require, and should be offered, liberal terms. No European or Eurasian colonist could settle, at present, who had not some capital at his disposal, and probably few would come until the agricultural prospects of the country were more clearly demonstrated. It would seem desirable that the government of the protectorate—

1. Should institute a model agricultural farm in some part of the highlands, and test experimentally the growth of different crops, both with and without irrigation.

2. Should investigate in the lower lands the prospects of perennial irrigation from the Juba, Tana, and Tsavo rivers.

3. Should record more systematically, and at more numerous stations than at present, the meteorological conditions.

4. Should make trial borings for artesian wells in a few places, selected by geological experts.

5. Should construct in the neighbourhood of the farm a small storage project as a model and guide to settlers.

It is quite certain that the agricultural advancement of the East Africa Protectorate must be slow. Irrigation works would be a material aid to that development, but it must not be anticipated that they will be anything more than supplementary to the natural conditions. The greater proportion of the country must necessarily be cultivated by means of the rainfall alone, and irrigation can only be practised in favoured localities which offer natural facilities. There can be no doubt that, whatever other prospects there may be before it, the country offers many advantageous agricultural conditions for the emigration both of Europeans and Indians; the construction of the Uganda railway has immensely increased the potential value of those conditions, and has advanced by many years the civilization and development of one of the most interesting countries in tropical Africa.

APPENDIX I.

LEVELS OF LAKE VICTORIA NYANZA.

	Port Alice—Entebbe.				Port Victoria.				Lubwa's.			
	Readings in feet and inches.			Rainfall.	Readings in feet and inches.			Rainfall.	Readings in feet and inches.			Rainfall.
	Max.	Min.	Average.		Max.	Min.	Average.		Max.	Min.	Average.	
1896.	ft. in.	ft. in.	ft. in.	in.	ft. in.	ft. in.	ft. in.	in.	ft. in.	ft. in.	ft. in.	in.
January	2 0	1 $9\frac{3}{4}$	1 $10\frac{1}{4}$	—	3 $8\frac{1}{4}$	3 5	3 $7\frac{1}{2}$	—	—	—	—	—
February	1 9	1 6	1 8	—	3 7	3 $1\frac{1}{2}$	3 $4\frac{21}{32}$	—	2 $1\frac{1}{2}$	1 8	1 11	—
March	1 7	1 4	1 $7\frac{1}{2}$	—	3 $6\frac{3}{4}$	3 0	3 $3\frac{3}{4}$	—	2 $0\frac{1}{2}$	1 $6\frac{1}{2}$	1 10	—
April	1 $7\frac{1}{2}$	1 $5\frac{1}{2}$	1 $6\frac{1}{2}$	8·61	3 5	3 $1\frac{1}{2}$	3 $3\frac{1}{2}$	—	1 $11\frac{3}{4}$	1 6	1 $9\frac{1}{2}$	—
May	1 $7\frac{1}{2}$	1 $5\frac{1}{2}$	1 $6\frac{1}{2}$	4·45	3 $4\frac{1}{2}$	3 3	3 $3\frac{1}{2}$	—	1 $10\frac{1}{4}$	1 7	1 $9\frac{1}{2}$	—
June	1 6	1 4	1 $4\frac{23}{36}$	3·18	3 $4\frac{1}{2}$	3 2	3 $2\frac{13}{16}$	—	1 $10\frac{1}{2}$	1 $7\frac{1}{4}$	1 $8\frac{3}{4}$	—
July	1 6	1 3	1 $4\frac{23}{31}$	0·31	3 $2\frac{1}{2}$	2 10	3 $0\frac{1}{2}$	—	1 9	1 4	1 $6\frac{1}{2}$	—
August	1 4	1 2	1 $2\frac{5}{16}$	4·10	3 $0\frac{1}{2}$	2 10	2 $10\frac{7}{8}$	—	1 $6\frac{1}{2}$	1 $3\frac{1}{2}$	1 5	—
September	1 $1\frac{1}{2}$	0 9	0 $10\frac{7}{16}$	2·37	2 10	2 5	2 $7\frac{1}{2}$	—	1 $4\frac{1}{4}$	0 $10\frac{1}{2}$	1 $2\frac{1}{4}$	—
October	0 9	0 5	0 $6\frac{3}{31}$	4·59	2 6	2 $2\frac{1}{2}$	2 $3\frac{7}{16}$	—	1 $1\frac{1}{2}$	0 9	0 $10\frac{1}{4}$	—
November	1 $2\frac{1}{2}$	0 6	0 $10\frac{1}{16}$	12·05	3 $0\frac{1}{2}$	2 4	2 $8\frac{1}{2}$	—	1 $6\frac{1}{2}$	0 8	1 $1\frac{1}{8}$	—
December	1 $3\frac{1}{4}$	1 $0\frac{1}{2}$	1 $1\frac{7}{16}$	4·69	3 0	2 9	2 $10\frac{1}{8}$	—	1 $5\frac{1}{4}$	1 2	1 $3\frac{1}{4}$	—
1897.												
January	1 2	0 $11\frac{1}{2}$	1 $0\frac{7}{8}$	1·74	2 $11\frac{3}{4}$	2 9	—	—	1 $4\frac{1}{2}$	1 2	1 3	—
February	1 2	1 0	1 $1\frac{1}{2}$	3·62	3 1	2 10	—	—	1 $6\frac{1}{4}$	1 $2\frac{1}{4}$	1 $4\frac{1}{2}$	—
March	1 $3\frac{1}{2}$	1 $1\frac{1}{2}$	1 $2\frac{1}{4}$	3·67	3 $1\frac{1}{2}$	3 0	3 $\frac{7}{16}$	—	1 $6\frac{3}{4}$	1 2	1 5	—
April	1 8	1 3	1 5	13·73	3 6	3 1	3 5	—	1 11	1 5	1 $7\frac{1}{2}$	—
May	1 10	1 8	1 $8\frac{1}{16}$	10·55	3 6	3 0	3 3	—	1 $11\frac{1}{4}$	1 $7\frac{1}{4}$	1 $10\frac{1}{2}$	—
June	1 $11\frac{1}{2}$	1 8	1 10	2·18	3 8	3 $3\frac{1}{2}$	3 $5\frac{1}{16}$	—	2 $3\frac{1}{4}$	1 10	2 0	—
July	1 $8\frac{1}{2}$	1 7	1 $7\frac{1}{4}$	3·69	3 $5\frac{1}{4}$	3 4	3 $4\frac{9}{16}$	—	2 0	1 7	1 $10\frac{1}{2}$	—
August												
September												
October	No records. Mutiny.								No records.			
November												
December												

LEVELS OF LAKE VICTORIA NYANZA.

	Port Alice—Entebbe.				Port Victoria.				Lubwa's.			
	Readings in feet and inches.			Rainfall.	Readings in feet and inches.			Rainfall.	Readings in feet and inches.			Rainfall.
	Max.	Min.	Average.		Max.	Min.	Average.		Max.	Min.	Average.	
	ft. in.	ft. in.	ft. in.	in.	ft. in.	ft. in.	ft. in.	in.	ft. in.	ft. in.	ft. in.	in.
1898.												
January				—				—				—
February				—				—				—
March				6·93				—				—
April	No records. Mutiny.			6·08	No records.			—	2 1	1 9	1 11¾	—
May				4·29				—	1 9	1 7	1 8½	—
June				0·65				—	1 10½	1 8	1 9½	—
July				4·47				—	1 9	1 7	1 8$\frac{31}{40}$	—
August				5·62				—	1 9¼	1 6¾	1 7½	—
September	2 4¾	2 4	2 4$\frac{9}{10}$		3 4	3 2	3 3		‡	‡	‡	
	Datum changed.*											
October	3 3¾	3 2	3 3	4·53	3 5	3 1½	3 3½	—	3 2½	3 0	3 1½	—
November	3 6½	3 1¾	3 4⅝	7·64	3 5½	3 1½	3 3½	—	3 2½	3 0	3 1¼	—
December	3 8	3 4¼	3 6⅜	1·63	3 6	3 1	3 3	—	3 3	2 10¾	3 0½	—
1899.												
January	3 4½	3 3	3 3	0·61	3 3	2 11½	3 1¼	—	3 1½	2 11	2 11½	—
February	3 7	3 2	3 3	3·46	3 1½	2 10	2 11$\frac{5}{10}$	—	3 0	2 9	2 10	—
March	3 4½	3 1¼	3 3	3·45	3 1½	2 9	2 11½	1·03	2 11	2 8½	2 9¾	—
April	3 6	3 1	3 3	9·15	3 2	2 7½	2 10$\frac{21}{30}$	3·38	3 1	2 8½	2 9¼	—
May	3 7	3 3½	3 4	8·56	3 7	2 10	3 3⅛	4·85	3 5¼	2 9½	3 1	—
June	3 6½	3 4½	3 5	3·02	3 6	3 0	3 2⅝	2·55	3 4	2 10	3 0¼	—
July	3 6½	3 2½	3 4	2·32	3 1	2 4½	2 8½	0·20	3 0	2 7	2 10	—
					Port Ugowe.†							
August	3 3½	2 9½	3 2	1·36	records	incomplete.		1·19	2 9½	1 10	2 1	—
September	2 9½	2 4½	2 6½	0·64	2 9½	1 11	2 3$\frac{9}{30}$	2·68	1 9	1 5	1 7	—
October	2 6½	2 5	2 4½		2 2	1 8	1 11$\frac{21}{31}$	2·91	1 5	1 1	1 3½	—
November	2 4½	2 2½	2 3	No record.	2 2	1 7	1 10$\frac{15}{30}$	5·48	1 2	1 1	1 1¾	—
December	2 5½	2 3	2 3½		2 8½	1 6½	2 0$\frac{1}{31}$	3·93	1 3	1 1	1 1¾	—

* Datum was, apparently, depressed about 8 inches.
† Port Ugowe is a new post which has been established on the lake in the place of Port Victoria abolished. It is the same place as Kisumu.
‡ Zero of gauge was depressed about 1 foot 6 inches or 1 foot 7 inches.

LEVELS OF LAKE VICTORIA NYANZA.

	Port Alice—Entebbe. Readings in feet and inches. Max.	Min.	Average.	Rainfall.	Port Ugowe. Readings in feet and inches. Max.	Min.	Average.	Rainfall.	Lubwa's. Readings in feet and inches. Max.	Min.	Average.	Rainfall.	Port Florence. Readings in feet and inches. Max.	Min.	Average.	Rainfall.
1900.	ft. in.	ft. in.	ft. in.	in.	ft. in.	ft. in.	ft. in.	in.	ft. in.	ft. in.	ft. in.	in.	ft. in.	ft in.	ft. in.	in.
January ...	2 $6\frac{1}{2}$	2 $5\frac{1}{2}$	2 5	2·26	2 5	1 10	2 $0\frac{15}{31}$	5·18	—	—	—	—	2 5	1 10	2 $0\frac{1}{2}$	5·18
February ...	2 $7\frac{1}{2}$	2 $6\frac{1}{2}$	2 $5\frac{9}{10}$	4·23	2 4	1 8	2 $0\frac{5}{10}$	6·45	1 5	1 1	1 4	—	2 $2\frac{1}{2}$	1 8	2 $0\frac{1}{2}$	6·45
March	2 8	2 7	2 $7\frac{1}{2}$	6·10	2 7	1 6	1 $11\frac{29}{31}$	4·65	1 5	1 1	1 3	—	2 7	1 6	1 $11\frac{1}{2}$	4·65
April	2 7	2 7	2 7	13·74	2 $4\frac{1}{2}$	1 9	2 $1\frac{7}{15}$	5·04	1 7	1 3	1 $4\frac{1}{2}$	—	2 $4\frac{1}{2}$	1 9	2 $1\frac{7}{15}$	5·04
May	2 8	2 7	2 7	2·70	2 9	2 1	2 $4\frac{21}{31}$	1·88	1 7	1 $4\frac{1}{2}$	1 $5\frac{1}{4}$	—	2 9	2 1	2 $4\frac{21}{31}$	1·88
June	2 $9\frac{1}{2}$	2 8	2 8	5·82	2 7	2 0	2 $3\frac{7}{10}$	2·26	1 $6\frac{1}{2}$	1 4	1 $5\frac{1}{2}$	—	2 7	2 0	2 $3\frac{7}{10}$	2·86
July	2 $10\frac{1}{2}$	2 $9\frac{1}{2}$	2 9	0·43	2 3	1 6	1 $11\frac{17}{31}$	0·05	1 6	1 $5\frac{1}{2}$	1 $5\frac{1}{4}$	—	2 3	1 6	1 $11\frac{17}{31}$	1·56
August	2 10	2 8	2 9	2·91	2 0	1 6	1 $9\frac{12}{31}$	2·70	1 6	1 5	1 $5\frac{1}{4}$	—	2 0	1 6	1 $9\frac{1}{4}$	2·70
September ...	2 $7\frac{1}{2}$	2 1	2 3	3·43	2 2	1 6	1 $9\frac{5}{10}$	3·66	1 5	1 0	1 3	—	2 2	1 6	1 $9\frac{1}{2}$	3·68
October ...	2 0	1 7	1 9	1·53	1 8	0 11	1 $2\frac{3}{31}$	2·89	1 0	0 $6\frac{1}{2}$	0 $9\frac{1}{4}$	—	1 8	0 11	1 2	2·89
November ...	1 7	1 5	1 $5\frac{1}{2}$	5·99	1 6	0 6	1 $1\frac{19}{30}$	6·27	0 $7\frac{1}{2}$	0 $4\frac{1}{2}$	0 $6\frac{1}{4}$	—	1 4	0 6	1 1	0·27
					Kisumu.*											
December ...	not recorded.			12·51	2 0	1 4	1 $7\frac{10}{31}$	2·15	1 3	0 6	0 10	—	2 $0\frac{1}{2}$	1 0	1 $1\frac{1}{2}$	6·23
1901.																
January ...	2 0	1 $9\frac{1}{2}$	1 11	3·88	2 0	1 4	1 $7\frac{10}{31}$	2·15	1 4	0 11	1 $1\frac{1}{2}$	—	—	—	—	—
February ...	2 $1\frac{1}{2}$	1 11	1 $11\frac{1}{2}$	4·11	2 2	1 1	1 $9\frac{2}{31}$	9·36	1 3	1 0	1 2	—	—	—	—	—
March	3 1	2 $1\frac{1}{2}$	2 $6\frac{1}{2}$	4·33	2 6	1 1	1 $11\frac{10}{31}$	7·66	1 11	1 $4\frac{1}{2}$	1 7	—	—	—	—	—
April	4 $4\frac{1}{2}$	3 2	4 $2\frac{1}{2}$	8·40	3 9	2 0	2 $9\frac{21}{28}$	10·75	2 11	1 6	2 2	—	—	—	—	—
May	5 $2\frac{1}{2}$	4 8	5 2	7·94	4 0	3 4	3 $7\frac{27}{31}$	3·85	3 $1\frac{1}{2}$	2 8	2 $10\frac{1}{4}$	—	—	—	—	—
June	—	—	—	5·57	3 $11\frac{1}{2}$	3 0	3 3	2·10	3 $0\frac{1}{2}$	2 5	2 6	—	—	—	—	—
July	—	—	—	4·01	3 4	2 5	2 $8\frac{22}{31}$	1·93	2 6	2 $0\frac{1}{2}$	2 $2\frac{1}{2}$	—	—	—	—	—
August	—	—	—	0·18	2 8	2 0	2 $4\frac{20}{31}$	0·35	2 1	1 6	1 $10\frac{1}{2}$	—	—	—	—	—
September ...	—	—	—	0·66	2 1	1 8	1 $11\frac{1}{2}$	0·61	1 8	0 $10\frac{1}{2}$	1 3	—	—	—	—	—
									Jinja.†							
October ...	Gauge moved. New datum.			1·94	1 10	1 7	1 $8\frac{22}{31}$	0·07	1 8	1 1	1 $5\frac{1}{2}$	—	—	—	—	—
November ...	3 $9\frac{1}{2}$	3 $7\frac{1}{2}$	—	2·28	1 $8\frac{1}{2}$	1 6	1 $7\frac{23}{30}$	6·08	1 2	0 $11\frac{1}{2}$	1 $1\frac{1}{10}$	—	—	—	—	—
December ...	3 9	3 6	—	3·72	1 7	1 2	1 $4\frac{5}{31}$	3·06	2 2	1 3	1 $7\frac{7}{10}$	—	—	—	—	—
1902.																
January ...	3 $8\frac{1}{4}$	3 5	3 $6\frac{1}{10}$	—	1 3	1 1	1 $1\frac{5}{31}$	—	2 $2\frac{1}{4}$	2 $0\frac{1}{4}$	2 $1\frac{2}{5}$	—	—	—	—	—
February ...	3 6	3 $8\frac{1}{2}$	3 $4\frac{1}{2}$	—	1 $1\frac{1}{2}$	1 $0\frac{1}{2}$	1 1	—	2 4	2 1	2 $2\frac{1}{4}$	—	—	—	—	—
March	3 8	3 $4\frac{1}{2}$	3 $5\frac{1}{2}$	—	1 2	1 $0\frac{1}{2}$	1 $0\frac{27}{31}$	—	2 3	2 1	2 $1\frac{1}{2}$	—	—	—	—	—
April	3 $8\frac{1}{2}$	3 3	3 6	—	—	—	—	—	2 $4\frac{1}{2}$	2 $2\frac{1}{2}$	2 $3\frac{1}{2}$	—	—	—	—	—
May	—	—	3 11	—	—	—	—	—	—	—	—	—	0 10	0 $3\frac{1}{2}$	0 $6\frac{1}{2}$	—
June	—	—	3 $9\frac{1}{2}$	—	—	—	—	—	—	—	2 $6\frac{1}{2}$	—	1 $0\frac{1}{2}$	0 4	0 9	—
July	—	—	3 $7\frac{1}{2}$	—	—	—	—	—	—	—	2 $4\frac{1}{4}$	—	1 $2\frac{1}{2}$	0 8	0 $10\frac{1}{2}$	—
August	—	—	3 6	—	—	—	—	—	—	—	2 $3\frac{1}{4}$	—	1 $3\frac{1}{2}$	0 6	0 $11\frac{1}{2}$	—
September ...	—	—	3 $4\frac{1}{2}$	—	—	—	—	—	—	—	2 $2\frac{1}{2}$	—	—	—	—	—

* Kisumu is the village on the gulf which was formerly called Ugowe. The site of the gauge was not altered.
† Jinja is a different site to Lubwa's, and about 10 or 12 miles from it. Jinja is close to the Ripon falls.

DAILY READINGS OF GAUGES ON LAKE VICTORIA NYANZA.

March, 1901.					April, 1901.					May, 1901.				
Date.	Entebbe.		Kisumu.		Lubwa's.	Date.	Entebbe.	Kisumu.	Lubwa's.	Date.	Entebbe.	Kisumu.	Lubwa's.	
	ft.	in.	ft.	in.	ft. in.		ft. in.	ft. in.	ft. in.		ft. in.	ft. in.	ft. in.	
1	2	1½	1	9	1 4½	1	3 2	2 3	1 7½	1	4 8	3 10	2 11	
2	2	1½	1	6	1 4½	2	3 2½	2 6	1 6	2	4 8	3 8	2 11	
3	2	2	1	11	1 5	3	3 2½	2 2	1 7	3	4 8	3 5	2 11	
4	2	2	2	2	1 9	4	3 3	2 4	1 7½	4	4 8½	3 8	2 11	
5	2	2½	2	0	1 5	5	3 3½	2 3	1 7	5	4 8½	3 10	2 11½	
6	2	3	2	2	1 4½	6	3 3½	2 5	1 8	6	4 9	3 8	2 11½	
7	2	3½	1	11	1 5½	7	3 4½	2 4	1 8	7	4 10	3 6	2 11½	
8	2	3½	1	7	1 6	8	3 5½	2 6	1 8	8	4 11	3 6½	2 11½	
9	2	4	1	8	1 6	9	3 6	2 0	1 9	9	5 0	3 9	2 9	
10	2	4	1	11½	1 7	10	3 7	2 3	1 9	10	5 0	3 7½	2 9	
11	2	5	2	1	1 7	11	3 7½	2 6	1 9	11	5 0	3 8	2 8	
12	2	5½	1	1	1 6	12	3 7½	2 3	1 9	12	5 1	3 11	2 8	
13	2	6	1	10½	1 5½	13	3 8	2 0	1 9½	13	5 1	4 0	2 9	
14	2	6	1	8	1 6	14	3 9½	2 4	2 1	14	5 2	3 7	2 10	
15	2	6	2	1	1 5½	15	3 10	2 6	2 2	15	5 2	3 9	2 11½	
16	2	6½	1	11	1 6	16	3 11	2 4	2 3	16	5 2	3 4½	2 11	
17	2	6½	1	7	1 8	17	4 0	2 6	2 3½	17	5 2	3 4	2 10	
18	2	6½	2	0	1 9	18	4 0	2 9½	2 6	18	5 2	3 6	2 10½	
19	2	6½	1	11	1 7½	19	4 1	3 1½	2 7	19	5 2½	3 5	2 11	
20	2	7	2	2	1 8	20	4 1½	3 3	2 6	20	5 2½	3 6	2 11	
21	2	7½	2	0	1 9	21	4 1½	3 3	2 6	21	5 2½	3 11	2 10½	
22	2	8	1	8	1 8	22	4 1½	3 3½	2 7	22	5 2	3 11	2 11½	
23	2	8½	2	1	1 7	23	4 2	3 6½	2 7	23	5 2	3 9	2 11½	
24	2	9	1	8	1 7	24	4 2	3 3	2 8	24	5 2	3 8	2 11	
25	2	9½	2	0	1 11	25	4 2½	3 8	2 9	25	5 1½	3 9	2 11	
26	2	10½	2	2	1 9½	26	4 2½	3 6	2 8	26	5 1	3 10	2 11½	
27	2	11	2	3	1 8	27	4 2½	3 6	2 9	27	5 1	3 10	3 0	
28	2	11	2	6	1 7	28	4 2½	3 9	2 11	28	5 1	3 7	2 11½	
29	2	11	2	3	1 7	29	4 4	3 6	2 10	29	5 1	3 7	2 11½	
30	3	0	2	6	1 7	30	4 4½	3 6	2 10	30	5 0	3 5½	3 0	
31	3	1	2	2	1 6½					31	5 0	3 8	3 1½	

From March 1 to May 15—
- Entebbe gauge rises 3 ft. 0 in.
- Kisumu „ 2 ft. 0 in.
- Lubwa's „ 1 ft. 7 in.

From April 1 to 30 (30 days)—
- Entebbe gauge rises 1 ft. 2 in.
- Kisumu „ 1 ft. 3 in.
- Lubwa's „ 1 ft. 4 in.

From April 30 to May 22 (22 days)—
- Entebbe gauge rises 0 ft. 10 in.
- Kisumu „ 0 ft. 5 in.
- Lubwa's „ 0 ft. 2 in.

From April 27 to May 1 (4 days)—
- Entebbe gauge rises 0 ft. 5½ in.
- Kisumu „ 0 ft. 4 in.
- Lubwa's „ 0 ft. 2 in.

From about April 15 to about May 1 (15 days)—
- Entebbe gauge rises 0 ft. 10 in.
- Kisumu „ (about) 0 ft. 15 in.
- Lubwa's „ 0 ft. 9 in.

APPENDIX II.

RAINFALL. EAST AFRICA.

	Approx. average rainfall in inches.		
Coast—			
Kismayu	14·9		
Malindi	38·3		
Lamu	28·9		
Takaungu	40·4	Average	
Mombasa	44·0	average 40·0	Average say 36
Chuyu (Wanga)	50·0		
Shimoni (Wanga)			
Inland—			
Kibwezi	25·7		
Machako's	34·0		
Fort Smith (Kikuyu)	44·6		say 36
Munia's (Kavirondo)	67·8		
Nairobi	say 40·0		say 60
Uganda—			
Entebbe	(?) say 50·0		

For details see "Annual Rainfall in British Africa in Inches" (p. 395 of *Report of the British Association*, 1901).

Before the reading of the paper, the CHAIRMAN (Colonel G. E. CHURCH) said: I now have pleasure in presenting Mr. Buckley, who will favour us with his paper on "Colonization and Irrigation in the East Africa Protectorate."

After the reading of the paper, the following discussion took place:—

Sir FRANCIS O'CALLAGHAN: I was fortunate in being in East Africa at the time the author of the paper just read was on his tour, and still more fortunate in having had the advantage of his company on the journey between Nairobi and Uganda proper, including the visit to the Ripon falls and the return across the lake to Port Florence. The author has touched but lightly on the question of colonization, but this question is of supreme importance to the future of East Africa. He mentions that the country might be peopled with surplus population from India. In this opinion I fully concur, and, moreover, that it is the only feasible plan for ensuring an industrious population, and for the supply of labourers for such portions of the country as may be suitable for white settlers. No matter how good the climate, white men will not do manual labour where they are surrounded by inferior black races. The difficulties now encountered in South Africa exemplify this fact. Until the vast regions still available in Canada, South Africa, and Australia have been filled, it seems unlikely that tropical Africa will attract white settlers except as planters or traders. The importation of Indians will, to begin with, be costly, as whole families must be brought over at the expense of the State, and supplied with food and shelter until they have time to clear and cultivate sufficient land for their own maintenance. The natives of East Africa, so far as the experience of the railway constructors go, are essentially lazy and incapable of sustained labour. So long as they can grow sufficient food to support life, they will not work continuously. When they find a dead animal they eat it raw, tearing off the flesh like wild beasts.

The soil for the most part in the districts traversed by the railway is rich, but very porous, hence rain falling on it rapidly disappears. The rainfall of one year compared with another seems very irregular, some being very dry, and others wet. The year previous to the author's visit was, as regards the district between the Great Rift valley and the lake, an exceptionally dry one, while since that visit in

April last there have not been three consecutive dry weeks, and only on two occasions have two weeks in succession been without rain. Shortly before the visit of the Secretary of State for the Colonies there was a downpour extending over a considerable area in this district, which exceeded an average of 1 inch per hour for four hours, doing much damage to the railway works. Had it not been for this damage it might have been possible to have taken Mr. Chamberlain's party right up to the lake, but his time being limited, no risk of detention could be taken.

The potato trade mentioned is making fair progress, the exports to Zanzibar and to South African ports being steady, and as much as 60 tons has been exported in a month. An export trade in beans, which promises well, has also arisen.

Regarding the author's remarks on the prospects of irrigation, it would be an impertinence for any one not himself an expert in this branch of engineering to criticize even favourably the opinions of one of the leading irrigation experts of India.

Sir HARRY JOHNSTON: I have not anything of very great importance to add to the interesting and instructive paper to which we have listened; in fact, I came here more to be informed than to offer any information. But I may perhaps add a few words about the subject of the gauges and the attempts to ascertain the varying levels of the Victoria Nyanza, and perhaps a few additional words about the Nandi plateau. I think one reason why there is such a remarkable divergence in the records of the levels of the lake is, that perhaps those of us who in the earlier days fixed the places where these levels were to be ascertained chose unwisely. Of course we thought, to begin with, of places which were safe and where we had European agents established; but Lubwa's, I should think, is not a good spot at which to get accurate levels of the Victoria Nyanza, for already there is a discernible current trending away to the Ripon falls and the discharge of the Nile, and this possibly may influence to a slight extent the level of the lake at Lubwa's compared with the level at Entebbe and some other points. I should be disposed to suggest, if we wished to get the general level of the Victoria Nyanza, the best way would be to obtain those records from some of the islands that fringe the northern shore, where the level of the water would be more generally distributed, and not so much driven up into narrow gulfs or affected by the outfall of the Nile at the Ripon falls. There is no doubt the effect of the wind on the Victoria Nyanza is very remarkable. At some seasons of the year it seems to establish—for the wind is not uniform—it seems to establish something like a regular tide, with an average foot rise and fall at the head of the narrow gulfs. Mr. Fowler, who is at the head of the Uganda Marine, and who has known the Victoria Nyanza now for several years, is of opinion that the effect of the wind is to establish a certain rocking of the lake, a certain uniform rise and fall, especially in the gulfs and estuaries, which are the places up to the present where most of these stations for recording the rise and fall have been established. Then another point that is interesting as regards the Victoria Nyanza is the discernible current right across the lake from the mouth of the Kagera (the most important affluent to the Victoria Nyanza), right across into Napoleon gulf, and so out at the Nile. It really looks as if the Kagera was the ultimate source of the Victoria Nile. Another interesting point for investigation, as our knowledge of Africa increases, is that the Victoria Nyanza seems to be a basin with a narrow rim all round. Perhaps it may be found that the structure of the rocks along the northern coast is such that it is possible for the waters to filter away through the rocks. Although there is only one ostensible outlet, yet you will find many streams rise within a few miles of Victoria Nyanza—rise from the rim and flow northwards to feed the Nile. When Captain Speke first traversed those regions, he actually believed and recorded on

his map that the Victoria Nyanza had four outlets. But, as a matter of fact, there is only one actual outlet; yet within a few miles of the waters of the Victoria Nyanza, from the slope of those hills or downs which rise to a height of about 1000 feet above the level of the lake, from their northern slope, pour away those marshy streams. Then again, on the south shore, it has been remarked how very near to the waters of the Victoria Nyanza rise the streams which flow into Lake Tanganyika. Again, all this considerable tract of country to the south of the lake is much below the level of the Victoria Nyanza. Here, again, we seem to have a very narrow rim of land that is but a little higher than the level of the Victoria Nyanza, and not very much higher than the lower country beyond the lake's basin; but it is quite conceivable that, by some slight change in the surface of the land here, the waters of the Victoria Nyanza might flood all Unyamwezi and drain away through the Congo basin to Tanganyika. Mr. Fowler, who has studied the Victoria Nyanza more perhaps than any other European, is of opinion that it is a remarkably shallow lake compared with Tanganyika. He went to the middle of the lake, and the deepest soundings were only 240 feet, which is comparatively trivial compared with Tanganyika. I might say a word of the very important province Kisumu (the Nandi plateau), which was not alluded to directly by Sir Francis O'Callaghan. If the Uganda Railway needed any justification as apart from a means of reaching Uganda, it would receive that justification in this tract of country, which is the most valuable part of the whole East Africa Protectorate. Here there are abundant streams of water; here you have in many parts no inhabitants at all, in any case fewer inhabitants than in the sparsely populated country round Nairobi. The land is more elevated, covered with rich grasses, and is entirely free from the tsetse fly, and I think is most obviously suited for the settlement of white people. No doubt, between the Rift valley and the coast there are many tracts which could be colonized by Indians.

Mr. T. E. Fuller (Agent-General for Cape Colony): I did not at all expect to be called upon this evening, and I have certainly no information whatever to add to the very interesting address which we have heard to-night, particularly from Mr. Buckley. I have been extremely interested in what I have heard, and been reminded of this fact: that the problems we have had discussed to-night are really the problems of all South Africa—I mean the irrigation problem; the great problem how to turn comparative desert, in which there may be various elevations, various descriptions of climate and population, into habitable country; and it has been my pleasure to talk to Mr. Buckley about our own problems in Cape Colony, and now in the Free State, and in the Transvaal, and they are very similar indeed to these problems which we have had described to-night. It may not be known, perhaps, to all that really there is no certain cultivation—I was going to say, south of the Zambezi—except just on the fringe of the coast, without irrigation. In the Transvaal, it is true, there are parts of the country where you may, to a considerable extent, reckon on rainfall; but taking it generally, apart from the fringe of the coast, you need the engineer to store your water, and bring the various tributary streams from the mountains. At the foot of the mountains the Dutch build their homesteads, so as to be near the watershed. I have been extremely interested in irrigation. Let me say there was no one more warmly interested in the whole of South Africa, more profoundly interested, than Mr. Cecil Rhodes. I had the pleasure of being a neighbour, a friend, a political and social friend, of Mr. Rhodes' for many years, and if we got a little dull over politics—for we frequently met—we used to lead him to the map of Africa; for he knew every part from north to south, and his table was one of the most interesting meeting-places, people from the interior constantly coming in with their little quota of information. There

are other problems, political problems, but we have all to learn that for the real advancement of the country, the material and physical problems are of far greater importance.

Captain R. CRAWSHAY: I do not know that I can add anything to the weighty paper now under discussion, unless it be a few words on Kikuyu, a district to which Mr. Buckley has made passing allusion. What he has said in its praise I can more than endorse, after a three years' residence there off and on. It is indeed a beautiful country, with a climate as healthy and pleasant as any man's heart can desire. It is primæval forest highlands lying at altitudes varying between 4500 feet and the regions of perpetual snow on Mount Kenya—or Kilinyatha, to give its native name —18,600 feet. As far as my experience goes, no malaria is present above 7000 feet. There are everywhere plenty of clear, cold perennial streams, also two rainy seasons, producing a regular rainfall similar to that of the west of Ireland. There is, therefore, no need of that irrigation which would be necessary to develop the Ikamba plains. Anything will grow—except such fruits and vegetables as thrive only in the extreme heat of the low enervating coast. But having said this, the practical question has to be considered, "Where will be the market for produce so raised?" If this problem can be satisfactorily solved, Kikuyu offers a promising and delightfully novel field for colonization by whites, with three advantages at least over South Africa. There is timber in abundance, giant timber, fit not only for local use, but probably destined in the future, like the forests of Western Australia, to supply the wants of other countries across the seas. There is everywhere ample water. There is a good supply of native labour in the Akikuyu—fine, strong, healthy men, whom I have always found willing to work provided they are considerately treated and not too heavily tasked at the commencement.

Colonel CHURCH: Mr. Buckley's paper is of immense practical importance. We discover countries, we explore them, we make our maps, we give a lecture, and we tell the world what we have found; but Mr. Buckley comes here this evening and tells us what we can do with what we have found, and how it may be adapted to the wants of civilization. But there is one thing, I think, that has not quite been told us, and that is, how are we going to get the white man to work alongside the negro? That is the great problem which the world has been trying to solve for very many centuries unsuccessfully. Whether it can be done in East Africa or not may depend upon the genius which is brought to bear upon the administration of the Protectorate. We are told here by Sir Francis O'Callaghan that the negro "will not work." Well, in that respect he is a great deal like the white man—he won't work unless he is obliged to. With reference to the Victoria Nyanza, we have heard much of value. If the evaporation is as great as Mr. Buckley indicates, but with reservations, it is a matter to be taken into consideration; but if, on the contrary, as Sir Harry Johnston says, the water may possibly be drawn off towards Tanganyika, or may water the country to the east of Tanganyika, then the ideas which have been expounded regarding this evaporation have to be somewhat changed. In fact, here is a problem of interest, not only to Africa, but to any country containing large lakes where the evaporation is so great as it is in the equatorial regions. The railway work we have heard described is not only a credit to engineering science, but a proof that English energy leads civilization by the hand. Mr. Buckley touches upon the great problem of irrigation. The turning of many rivulets upon a thirsty soil has made powerful nations; the irrigated *vegas* of Spain were the true sources of the glory of its Moorish kingdom for 750 years; the vast belt of arid country extending from the eastern Mediterranean sea across Anatolia, Syria, ancient

Persia, and into north-eastern India, has witnessed the rise and decay of many an empire, the grandeur of which has been due to the little threads of water which have trickled over its lands guided by the hands of the husbandman. The human race appears to seek such arid districts by preference, and this has been so from the earliest times, as is attested by the ruined cities of Central Asia. The Peruvian neglected the fertile lands of the Amazon valley slope for the arid lofty plateaux of the Andes. Similarly, the Mexicans shunned the tropical districts for the dry tablelands, which, by irrigation, they made the basis of a state which reached the highest status of barbarism found in any country of the New World by the Spanish conquerors. To-day the United States has adopted a plan for irrigating its arid lands on a vast scale, and is applying a fund of several millions of dollars yearly to the work with immense beneficial results. In California, from 10 to 20 acres of irrigated land are now considered as the equivalent of 160 not thus treated.

Would it not be wise to give the native population of East Africa a few object-lessons in irrigation? Perhaps the judicious application of £100,000 would do this with great resultant benefit to the railway and to all concerned. I think it only remains for me to thank Mr. Buckley for his extremely interesting paper, knowing that in doing so I only express your wishes.

GEOGRAPHICAL DISTRIBUTION OF VEGETATION IN YORKSHIRE.

By Dr. WILLIAM G. SMITH, Yorkshire College, Leeds, and C. E. MOSS, B.Sc.

INTRODUCTION.

The two maps * and accompanying text, here submitted, are the results of a survey of the vegetation in the West Riding of Yorkshire, conducted on principles which have not previously been employed in England. The work was begun in 1898, in order to test in Yorkshire the method of botanical survey which the late Robert Smith was at that time developing in Scotland. On the completion in 1900 of the first maps of the Scottish Botanical Survey—Edinburgh and North Perthshire (1900) †—it became evident that the method gave good results; and the survey of the West Riding was then systematically undertaken as opportunity offered. The first results of the experiment, maps covering over 1700 square miles and a summary of observations, are now submitted. It is considered most convenient to publish these in two parts, the first including the south-western district of the West Riding, the second including the north-east part of the Riding. In the first part Mr. Moss's work is incorporated, Mr. Rankin's in the

* The second paper and map will probably be published in June.

† The numbers in brackets after an author's name indicate the year in which a book or paper was published. The titles of the works referred to will be found in the List of References at the end of this paper. The authors' names are arranged alphabetically, and the papers of each author in chronological order, with the year-number in brackets. In the case of a periodical, the number in brackets is the year of publication of the paper referred to.

second part, although their observations have by no means been strictly confined to these areas. The survey has been carried beyond the limits of the present maps, and practically all the West Riding, with parts of the North Riding, are completed. It is, however, advisable to keep the maps uniform in size, and to issue them as a series, so that the work done beyond the present limits will appear later.

The principles of the method have already been explained elsewhere, but a brief summary will probably be useful. The vegetation of any area may be considered from two aspects, distinct yet closely related. One may set out to find an answer to the question, "What species occur here?" or to solve "How are the species arranged with regard to one another, and with regard to soil and climate?" The result in the former case would be a flora; in the latter it would be a connected account of the vegetation. The floristic method has as its first object the recording of all the species found in an area; these, arranged under genera and natural orders, with notes on habitat and frequency or rarity, would constitute the flora of the district. The present and past distribution of the species or genera over the Earth, and the history and migration of the race, are wider questions of floristic interest. The botanical characters of most importance here are those of the race, especially the floral organs. The production of floristic maps in Britain was begun by H. C. Watson (1843); these showed the areas of distribution of species or genera.

The study of vegetation, on the other hand, recognizes that there is a close connection between the plants of a country or other area, and the prevailing conditions of soil and climate. Thus the vegetation of a dry district is distinct from that of a rainy one; or, in a narrower sense, the vegetation of an upland pasture is different from that of a lowland marsh. In the floristic sense, the plants growing together under uniform conditions of soil and climate may have no kinship; yet the fact that they grow together indicates an œcological relationship. From this aspect, "the essential characters of the species are those indicating adaptation to the environment, and are to be found mainly in the vegetative organs" (Smith, R., 1899). After some experience in examining vegetation, the recognition of biological communities or societies is acquired. However large or small the number of species included in such a plant-society may be, it is possible to arrange them under three subdivisions. (1) Dominant social forms: one or more species, whose presence is in the first place determined by conditions of climate, soil, and environment suited to their requirements; while their dominance is the result of gregarious or social habit. Thus heather and grasses are dominant social forms, while trees, also social, obtain an additional advantage from size and age. (2) Secondary or subordinate social forms struggling for dominance. (3) Dependent species

protected by the dominant forms, or living in the humus beneath them. The scope of such a plant-society may be wide or narrow, according to the selection of dominant forms. For example, heather, grasses, oak, and pine are four dominant social forms characteristic of groups which are wide and inclusive. These may be designated types of vegetation. Within a heather moor smaller communities exist where *Calluna*, *Erica Tetralix*, or *Juncus* are characteristic of more or less limited spheres dependent upon local conditions of soil and water-supply. These are narrower in their scope, and may be called plant-associations. In describing any region the selection of associations or types depends largely on how detailed a survey is attempted.

The plan followed in the present survey is largely founded on the work of Prof. Flahault, of Montpellier, who is carrying out a survey of the vegetation of France based on the distribution of certain trees (1897). A number of trees are social, and tend to form forests where one or two species prevail and more or less completely exclude all others. From a geographical point of view, forests of a particular tree indicate certain climatic and soil conditions; from a botanical point of view, the presence of particular associations of subordinate species; and from an economic point of view, regions suitably situated for the growth of certain cultivated species and for certain industries. The botanical survey of Scotland was a direct outcome of Flahault's work; for R. Smith, while a student at Montpellier, accompanied him on excursions. Flahault's method of representing the vegetation by recording the distribution of selected forest trees on a map was at first proposed in Scotland; but R. Smith decided that this would give an inadequate, if not erroneous, impression of the plant-covering of the country. The almost total absence of primitive forest in Britain and the great proportion of cultivated land have so changed the original and natural vegetation of the country, that a map according to Flahault must be to a great extent hypothetical. R. Smith then decided that a statistical map of the vegetation was first necessary as a basis in preparing either forest maps or maps showing the plant associations. A scheme of types of vegetation was drawn up; and the results already published (1900), as well as unpublished, show that the method will do much to assist towards a clearer conception of the vegetation of Britain. The same principles have been applied in Yorkshire.

Detailed maps of vegetation representing natural subdivisions of North America are constructed by the staff of the U.S.A. Department of Agriculture (1898). In the series of monographs edited by Engler and Drude (1897), vegetation maps are also issued, but the scale used is much smaller than in our case. Maps of isolated forest areas, with the dominant trees indicated by colouring, have also been prepared for many parts of France, Germany, and Russia, but none of them attempt a continuous area.

The general programme of a vegetation survey was discussed by R. Smith (1900). The chief points to be considered may be summarized as follows:—

(*a*) The chief zones or regions, characterized by definite plant associations, into which the district may be most conveniently divided.

(*b*) The particular conditions of soil and atmosphere which distinguish each zone or region.

(*c*) The adaptations of the plant-species to their environment.

(*d*) The relations existing between the species—that is, which species are dominant, which subdominant, and which dependent upon the dominant species for shelter or for food.

(*e*) The influence of animals and of man upon the associations.

(*f*) The general conditions of climate and of vegetation in the district compared with those in other districts.

The method of survey is to traverse the selected area till its prominent associations are recognized. The extent of country observed in a single excursion is variable, and depends on whether the vegetation is uniform and easily accessible, or the contrary. It may be necessary to traverse a difficult area at distances of a few hundred yards; but the routes may be farther apart where the vegetation seen from a distance is found to be uniform. Opportunities of checking previous observations occur when a place already visited is seen from another vantage, or when two routes cross, as they frequently do. In preparing the maps, the limits of prominent associations are ascertained and recorded on the field-map on the spot. The maps used for outdoor work are generally the "1-inch" sheets of the Ordnance Survey, although in some cases the "6-inch-to-mile" sheets are preferable. The published maps are on the scale of 1-inch to 2 miles; a convenient size for publication with a small number of types of vegetation. The number of types on the published maps does not, however, represent all those recognized in field-work, but they are taken as sufficient to effect a primary analysis of the vegetation. A less apparent but more important work is to collect information regarding associations. When an association is recognized, the plants found there are recorded in a field notebook, with the order of their occurrence as dominant, secondary, or dependent species, also their state of flowering. Other observations are made regarding subjacent rocks or deposits, conditions of drainage, altitude, exposure, and environment generally. The records thus obtained are important not only as information about the vegetation and its local conditions, but also as standards for comparison. One type of vegetation has to be compared with another quite distinct in character; or it frequently happens that an association as developed in one place has to be compared with another somewhat similar, but in a different locality. It is only by careful notes that one overcomes the difficulty of carrying on the survey during a series of

excursions extending through two or three years. The field-notes are also invaluable when one observer wishes to compare results with another.

The maps are prepared entirely from our own observations; but in the preparation of the paper the existing literature on the vegetation of the West Riding has not been ignored. The 'Flora of West Yorkshire' (F. A. Lees, 1888) and 'North Yorkshire' (J. G. Baker, 1885) are indispensable in considering the plant geography of the county. In both these works, Thurmann's (1849) attempt to classify vegetation according to the mechanical constitution of the underlying rock has been adapted to Yorkshire; and lists of characteristic species given. 'West Yorkshire' (Davis and Lees, 1880) has also been referred to, especially for the lists of plants of definite localities, which have been useful guides, although not arranged according to the principles followed in this survey. In matters relating to the geology of the area we are indebted to Mr. P. F. Kendall, of Yorkshire College, in a degree which is beyond formal acknowledgment. The introduction to Mr. Crump's 'Flora of Halifax' (1901) has proved of great service, because it follows the lines of our work. Other sources of information are Mr. Rothery's 'Flora of Skipton,' and the publications of the Yorkshire Naturalists' Union. We have also to acknowledge assistance from Mr. T. W. Woodhead, of Huddersfield, on the flora of that area; Mr. R. C. Gaut for assistance in the survey of parts, and for lists; and many others who have taken the trouble to ascertain details necessary to the survey. We have specially to acknowledge our great indebtedness to Mr. J. G. Bartholomew, not only for the reproduction of the maps, but for much assistance in other ways.

PART I.: LEEDS AND HALIFAX DISTRICT.*

If the area represented in the present map be traversed from east to west on one of the railroads, the impression is first received of a thickly populated manufacturing area, with numerous collieries. In the western half, towns are less numerous; and valleys with grassy slopes, dotted with villages and homesteads, are presented. The woods are limited to the stream-sides, while moorland edges form a fringe along the skyline. With the aid of a good map, such as those of the Ordnance Survey or Messrs. Bartholomew's latest maps of the county, the towns seen in their true proportions are found to occupy less of the area than the earlier impressions led one to expect; and some idea of the numerous woods and extensive moors is obtained. In the preparation of this vegetation map, the areas represented as wood, uncultivated land, and cultivated land respectively on the ordnance maps, form a

* Map, p. 484.

basis for the work; the limits of these are taken as correct unless observations on the spot show otherwise.

The vegetation of the area presents three subdivisions—

1. The Moorland.
2. The Woodland.
3. The Farmland.

1. The Moorland.

The political boundary between Yorkshire and Lancashire traverses the moorland throughout almost all this map; it therefore offers a convenient western limit. In order, however, to represent fully the characters of the vegetation, this limit has been taken far enough into Lancashire to show the falling slopes on that side of the Pennines. The highest altitudes of the moors are 1700 feet (515 metres) * on Boulsworth hill in the north-west, and 1909 feet (579 metres) on Black hill (Holme Moss) in the south. Thence the moors are almost continuous down to 1250 feet (380 metres), and in places descend to 900 feet (273 metres). The western part of the map is an extensive Millstone Grit plateau, dissected by numerous streams, which have cut their way through the surface rock, and formed deep narrow valleys, or "cloughs," in the shales below. In a few cases, the shales of the Pendleside or Yoredale series are reached at the bottom of these valleys. In the east, the Carboniferous Coal Measures overtop the gritstone rocks. Glacial clay is found on the moors west and north of Bradford, but is absent from the Calder-vale moors and southwards. The geology of the district is therefore very simple; and for œcological purposes, the area may be regarded as composed of hard rock and shale, both sandstone. The vegetation of the moorland is shown on the map under three primary divisions, each of which is easily recognized by its predominating colour when seen in mass: (1) the cotton-grass moor, greyish-green in early summer, and reddish-brown in autumn; (2) the heather, brown in winter, and passing through a summer green to autumn purple; (3) the rough grass, green in summer and yellowish-brown in winter. The selection of these types of vegetation is based, however, not on mere ease of recognition, but on broader principles, namely, difference in soil, water-supply, and other conditions of environment, which will be dealt with more fully later.

Moss Moor.—The great part of the moors is dominated by the cotton-grasses (*Eriophorum vaginatum* and *E. angustifolium*). The heather (*Calluna*) and the grass heaths are, as a rule, confined to the drier or steeper edges, or to isolated, outlying flanks and patches. The common cotton-grass (*E. vaginatum*), with its associates, extends in monotonous tufts for miles, and in this latitude forms the backbone of "the backbone

* The altitudes are those given on the maps of the Ordnance Survey.

FIG. 1. On a Cotton-grass moor. The bog-tarn rests on clay at the base of the peat; the banks show the depth of peat. The background is the drier moor on deep peat.

FIG. 2. Moss moor in June. Cotton-grass in fruit.

of England" itself. The cotton-grass flourishes best on the almost flat moor summit, where the rainfall is great, the drainage bad, and the peat thick and permanently wet or damp (Fig. 1).* These moors are locally known as "mosses;" and the vegetation of the area is extremely scanty in number of species. A few mosses and liverworts lie on the bare peat, a few species of algæ and lichens are not uncommon, now and then small fungi are seen, ferns are practically absent, and clubmosses are but rarely met with. The following are the flowering plants found in extreme cases of this Eriophorum association:—

†*Eriophorum vaginatum*, L. Usually dominant.
E. angustifolium, Roth. Sometimes dominant.
Empetrum nigrum, L. Occasionally dominant.
Rubus Chamæmorus, L. Sometimes abundant.
Vaccinium Myrtillus, L. Sometimes abundant.
Calluna Erica, DC. Not abundant.
Erica Tetralix, L. Not abundant.
Carex curta, Good. Infrequent.
Drosera rotundifolia, L. Rare.
Narthecium Ossifragum, Huds. Rare.
Lycopodium spp. Very rare.
Selaginella selaginoides, Gray. Very rare.

Such tracts are usually most monotonous in appearance. In autumn and winter, the reddish-brown leaves of the cotton-grass present a dreary aspect. Some life is infused into the area in early spring, when the dull florets make their appearance. In early summer the masses of white fruits form snow-like patches visible from a considerable distance (Fig. 2). The Eriophorum association is not extensively developed in Perthshire or Midlothian (1900), though R. Smith's unpublished maps show it to be of great extent in the west of Scotland. It is thus an association typical of the western region of Britain, and it seems probable that the association does not reach its maximum development with a rainfall of less than 40 inches (100 cms.). The recording stations of the Halifax waterworks, situated in the Eriophorum area, indicate a mean annual rainfall of nearly 45 inches.

The Eriophorum moor is an example of the association known to German botanists as "Heidemoor" or "Moosmoor," and may be indicated by the English term "moss" or moss moor. The *Sphagnum*, or bog-moss, is regarded as an important element in the formation of the deep peat always found on the moss moor; yet in our area, while the peat is from 5 to 30 feet deep, *Sphagnum* beds are by no means conspicuous. The general impression received is that the peat is being gradually denuded or wasted; and this agrees with the conditions found in the neighbouring Kinderscout district of Derbyshire, as described by Sir E. Fry (1892).

On the bleak ridges of the upper moors the bilberry (*Vaccinium*

* The photographs for this paper were taken by Mr. W. B. Crump, M.A. (Halifax), who has generously placed them at our disposal.

† The nomenclature of the London Catalogue, 9th edit., is followed throughout.

Myrtillus), a secondary social form of the Eriophorum and Calluna associations, becomes a rival for dominance; and in dry, rocky, wind-swept places it replaces the cotton-grass entirely. It has been considered advisable to record this type of vegetation on the map, because it has a connection with the Vaccinium slopes, recorded from 2000 feet upwards in Perthshire. Although the bilberry is nowhere so dominant or so extensively developed in the present map, the occurrence of the Vaccinium summit-ridge is characteristic (Fig. 3). It is not determined by altitude alone: its essential feature is that it forms the sky-limit of the moor, where it is exposed to all weathers. It is much drier than the "moss" below, more rocky, steeper, better drained, and the peat is shallower. The stations where this Vaccinium association occurs are—Holme moss (1750 to 1900 feet), Boulsworth hill (1650 to 1700 feet), West Nab (1500 to 1640 feet), and to a smaller extent on other summits. The rocky edges of the various moors are also tenanted by much Vaccinium. The following plants are characteristic:—

Vaccinium Myrtillus, L. Dominant.
Empetrum nigrum, L. Often abundant.
Rubus Chamæmorus, L. Occasionally abundant.
Calluna Erica, DC. Common.
Rumex Acetosella, L. ,,
Juncus squarrosus, L. ,,
Eriophorum vaginatum, L. Common.
E. angustifolium, Roth. ,,
Deschampsia flexuosa, Trin. ,,
Festuca ovina, L. ,,
Nardus stricta, L. ,,
Lycopodium spp. Rare.

The case of Black hill (Holme Moss) is exceptional, because vegetation is almost completely absent for fully half a square mile at the summit. The surface here consists of black, damp or slushy, decaying peat, with no emerging rocks. Almost the only vegetation is afforded by the creeping shoots of *Eriophorum angustifolium*, which bind together to some extent the loose peat.

The Eriophorum moor and the Vaccinium ridge represent types of vegetation where the influence of man is very slight, because both are unsuited either for grazing or game. In the former, wide ditches are occasionally constructed to encourage drainage and the consequent growth of bilberry and heather, plants better adapted to the habits of grouse than the Eriophorum. The marked scarcity of heather on the moss moor is not emphasized in any literature relating to the vegetation of this district; in fact, the impression is conveyed that heather is the dominant plant. Whether the area now occupied by Eriophorum was formerly covered with heather is a question difficult to answer; but vegetation maps such as the present will furnish in time to come a basis for comparison of this and other changes of flora.

Heath or Heather Moor.—The heather (*Calluna*) becomes dominant only on the edges of the moss moor or on detached patches (Fig. 4). The heather area in South-West Yorkshire is much more limited than that of Northern Perthshire or North-East Yorkshire. Peat is present

FIG. 3. Summit ridge of Boulsworth Hill. The vegetation is chiefly Vaccinium.

FIG. 4. Crimsworth Head. Edge of a cotton-grass moor, with dark patches of heather on the slopes and grasses near the stream.

on the heath, varying from 3 or 4 feet in thickness to a few inches; whereas on the Eriophorum moor the peat is sometimes 30 feet thick. The heaths are flat, or nearly so; and steep shaly hillsides are not heather-clad. The heather grows thickest and tallest in those places which are naturally well drained, and which are regularly and carefully fired by the keepers. The following plants are representative of the heather moor on the present map:—

Calluna Erica, DC. Dominant.
Ulex Gallii, Planch.
Genista anglica, L.
Potentilla sylvestris, Neck.
Vaccinium Vitis-Idæa, L.
V. Myrtillus, L.
Erica cinerea, L.
Pyrola media, Sw. Rare.
Trientalis europæa, L. (one station).
Rumex Acetosella, L.
Orchis latifolia, L. Rare.
Luzula erecta, Desv.
Juncus squarrosus, L.
Scirpus cæspitosus, L.
Carex Goodenowii, J. Gay.
C. flacca, Schreb.
C. panicea, L.
Agrostis vulgaris, With.
Festuca ovina, L.
Nardus stricta, L.
Lomaria Spicant, Desv.
Lastræa Oreopteris, Presl.

In wet places the following also occur:—

Erica Tetralix, L.
Ranunculus Lenormandi, F. Schl.
Drosera rotundifolia, L.
Andromeda Polifolia, L. Rare.
Narthecium Ossifragum, Huds.
Juncus conglomeratus, L.
Potamogeton polygonifolius, Pour.
Carex echinata, Murr.
C. flava, L.
Deschampsia cæspitosa, Beauv.
Molinia varia, Schrank.
Sphagnum spp.

The heather vegetation, as will be seen, includes a greater variety of plants than that of the higher moors, and within itself presents several well-marked associations. Graebner, in a recent paper (1901), recognizes the heath or heather moor ("Calluna-heide") as a type of vegetation co-ordinate with the moss moor; but his description of the latter is confined to its occurrence at low altitudes only. He also recognizes as types "Tetralix-heide" and "Empetrum-heide," both of which are found in the present area. The Tetralix association forms a transition between our two types, occurring on the wet parts of the heath and on the margins of the moss moor; where well marked, it is shown by the letters "EH" on the Eriophorum moor colour. Graebner further subdivides his type into "Facies," most of which have been recognized in this survey, and in a more detailed scheme of colour could be represented.

Grassy Moorland.—The term "grass heath" (HPa) is here used to distinguish this vegetation from that which we call "natural pasture" (Pa). The latter is well developed on the moorland of the Mountain Limestone, and is characterized by a large number of plant-associates which do not belong to the heather vegetation. The grass heath, on the other hand, while dominated by grasses, includes many species already given as heath plants. The distinction thus made is recognized by

continental botanists, who use the term "Gras-heide," while our natural pasture corresponds to their "Wiesen." The grass heath of the present area, like the Calluna heath, is always on the edge of the moor plateau. Two types of grass heath occur: one is flat or nearly so, wet, somewhat peaty, and dominated by *Molinia* (Fig. 5); while the other occurs on steep slopes, and is dry, almost without peat, and dominated by *Nardus stricta*, *Deschampsia flexuosa*, and *Festuca ovina*. The best example of the former is Erringden Moor: the latter is extensively developed on the shaly slopes around Todmorden. The following is a selected list from the Molinia association:—

Molinia varia, Schrank. Dominant.

Viola palustris, L.	*Juncus squarrosus*, L.
Montia fontana, L.	*J. conglomeratus*, L.
Lotus uliginosus, Schkuhr.	*Luzula erecta*, Desv.
Hydrocotyle vulgaris, L.	*Carex echinata*, Murr.
Galium Witheringii (Sm.).	*C. flacca*, Schreb.
Vaccinium Myrtillus, L.	*C. flava*, L.
Schollera Oxycoccus, Roth.	*C. Goodenowii*, Gay.
Calluna Erica, DC.	*C. binervis*, Sm.
Erica Tetralix, L.	*Deschampsia flexuosa*, Trin.
Narthecium Ossifragum, Huds.	*Nardus stricta*, L.

The dry grass heath occurs on the steep hill-slopes; and for this reason, probably, there is no peat. It is better suited for pasturage than the wet grass heath. The following species are represented:—

Festuca ovina, L. } One or both	*Calluna Erica*, DC.
Nardus strica, L. } dominant.	*Erica cinerea*, L.
Deschampsia flexuosa, Trin.	*Rumex Acetosella*, L.
Aira præcox, L.	*Orchis maculata*, L.
Sieglingia decumbens, Bernh.	*Luzula erecta*, Desv.
Agrostis vulgaris, With.	*Carex pulicaris*, L. Not common.
Viola lutea, Huds. Local.	*C. pilulifera*, L.
Genista anglica, L. Not common.	*C. binervis*, Sm.
Ulex Gallii, Planch.	*Pteris aquilina*, L.
Potentilla sylvestris, Neck.	*Lomaria Spicant*, Desv.
Galium saxatile, L.	*Lastræa Oreopteris*, Presl.
Vaccinium Myrtillus, L.	

On the whole, the grass heaths of this part of Yorkshire are limited in extent compared with North Yorkshire and Scotland. They also show fewer species, and are deficient in plants indicating good soils.

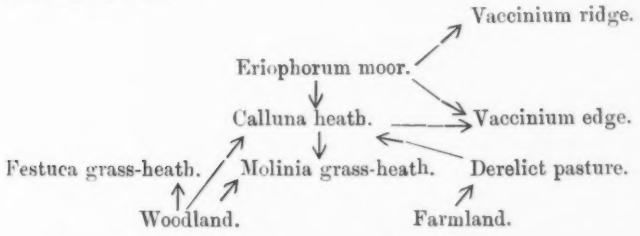
At the upper limit of cultivation many farms are derelict, or rapidly becoming so. Some of the pastures here are quite heathy in character, and are said by the farmers to be "running back to moor." The pastures furnish a connecting link between the heaths and the area of cultivation. They possess a rich and varied flora, many local rarities being found there. In addition to the heaths and grasses of the heaths, the following occur:—

FIG. 5. Walshaw Dean. Grass heath in the moorland valley of a stream. Cotton-grass moors on distant heights.

FIG. 6 The Undergrowth of an open oak wood.

Viola lutea, Huds. Local.
Hypericum pulchrum, L.
H. quadratum, Stokes.
Linum catharticum, L.
Ulex Gallii, Planch.
Cytisus scoparius, Link.
Cratægus Oxyacantha, L.
Antennaria dioica, R. Br. Rare.
Gnaphalium sylvaticum, L. Rare.
Taraxacum palustre, DC.
Wahlenbergia hederacea, Reichb. Rare.
Erythræa Centaurium, Pers. Not common.
Gentiana Amarella, L.
Digitalis purpurea, L.
Euphrasia officinalis, L.
Thymus Serpyllum, Fr. Rare.
Teucrium Scorodonia, L.
Betula pubescens, Ehrh. (dwarfed).
Quercus Robur, L. (dwarfed).
Salix aurita, L.
Habenaria conopsea, Benth.
H. bifolia, R. Br.
H. viridis, R. Br. Not common.
Luzula erecta, Desv.
Carex, spp.
Briza media, L.
Ophioglossum vulgatum, L.
Botrychium Lunaria, Sw.

The relations of the foregoing moorland associations may be briefly summarized thus:



This table also furnishes some idea of the development of the various types of moorland. The Eriophorum moor passes upwards into the Vaccinium ridge and downwards into the Vaccinium edge and Calluna heath. It is also noteworthy that the Calluna heaths are all within the present altitudinal range of woodland, and remains of tree-trunks are occasionally found embedded in the peat. Amongst workers in North-West Germany, it is generally acknowledged that much of the heath area has been derived from former forest (Smith, W. G., 1902B). Whether the great stretches of Eriophorum moor have in post-glacial times been tree-clad is uncertain. The grass heaths are all of the heath type; but the Molinia type shows this relationship better than the Festuca heath. The latter, being on steep, shaly hillsides, was probably never covered with peat at all. It is possible that much of the grass heath was once wooded, and in a forest map would be shown in the upper oak forest zone. The heath and hill-pasture abut on the area of cultivation; and the upper farms have been enclosed from these, leaving a ragged fringe of moorland which has never been brought under the plough, either because too steep or too rocky. By selection, certain portions might profitably be converted into farmland; while it appears certain that good forestry would convert nearly all of these places into woodland.

2. The Woodland.

Woods occur from the edge of the moorland plateau down to sea-level. Throughout the whole area the oak is the dominant tree. In Flahault's vegetation survey of the south of France, ten types of forest are represented. In R. Smith's Scottish survey there are five, namely, oak, birch, pine, larch, and mixed lowland deciduous. In the present map, only three of these are considered worthy of special colours, namely, oak, mixed lowland (with beech), and pine. The birch wood or uppermost tree zone of the Scottish highlands is represented in the West Riding by a modification of the oak wood. Larch woods, so characteristic of the Scottish moorlands, are here quite subordinate, and included under pine woods. In the present paper the oak woods alone will be dealt with, the consideration of pine woods being deferred. The beech wood, so typical of Central Europe, is not well represented in South-West Yorkshire, except on or near the Permian tract. Beech is not uncommon, but its occurrence in parklands, or as small detached plantations, suggests artificial planting; and it seems best to consider it as an introduction into the oak wood. The woods where beech and other lowland deciduous trees outnumber the oak, are indicated on the map, because the presence of these trees tends to alter the whole character of the vegetation growing beneath; and where beech is present in quantity the association approaches that of the typical beech forest (Figs. 6 and 7).

Before considering the botanical features of the woodland, the topographical features of this area are of interest. The orographical maps of the ordnance survey, or those recently issued by Messrs. Bartholomew, show that the western or moorland area of the map is an almost continuous plateau, ranging from about 1250 feet upwards. The middle portion of the map consists of valleys and intervening uplands, sloping from the plateau downwards to the lowlands or eastern part of the map. Accompanying the general lowering of altitude from west to east, there is a decrease in the annual rainfall (see p. 396). The geology also changes with the decreasing altitude; and the western Millstone Grit gives place to the Coal Measures as surface rocks. This boundary is approximately indicated on our map by the places Hepworth, Huddersfield (west side), Stainland, Elland, Halifax (east side), Ogden, and Leeming; thence it turns eastward, passing near Shipley, Calverley, Kirkstall, and Roundhay (Leeds), and under the Permian near Barwick-in-Elmet. The Permian series occurs in the extreme east of this map, the boundary between it and the Coal Measures passing southwards from Garforth to Pontefract and Hickleton. The contour of the woods on our map offers a ready but fairly accurate means of distinguishing the Millstone Grit from the Coal Measure area. In the former the valleys are narrow with steep sides, and the woods

FIG. 7. The effect of Beech on the undergrowth.

appear as narrow strips; in the latter the valleys are broad with gentle slopes, and the woods in consequence appear broader and rounded.

Oak Woods.—In the narrow western valleys the woods usually occur on the slopes and rarely rise to the open upland. As the valleys widen out on the Coal Measures, the oak woods are still mainly confined to the valleys, but emerge more from them. Three types of oak wood are recognized—

1. Clough Thicket or Wood.
2. Upland Oak Wood.
3. Lowland Oak Wood.

The lowland oak wood occurs below about 500 feet (152 metres). The dry oak wood occurs chiefly above this altitude, and extends upwards to 800 or 1000 feet, where it merges into the clough wood.

The Clough.—The moorland plateau of Millstone Grit finishes in a precipitous edge; and the waters from the moor, gathered into narrow but well-marked streams, descend abruptly over this edge, excavating it backwards and downwards to form a gorge, with a steep head and steep rocky slopes littered with weathering sandstones and shales. These gorges are locally known as "cloughs." The abrupt change in altitude and environment is at once perceptible in the vegetation, which changes rapidly from that of the moor edge to a loose thicket of shrubs and low trees, in many respects stamped with the characteristics of a wood. A useful account of the geology and natural history of Norland Clough is given in a series of papers in the *Halifax Naturalist* (1900). The typical clough is not crowded with tree vegetation; but trees and shrubs are abundant enough to form a loose thicket or scrub, sometimes dense enough to be regarded as a wood of the next class (Fig. 8). The following constitute the scrub of the clough :—

Oak.	Blackthorn.	Rose.
Birch.	Bird-cherry.	Bilberry.
Mountain Ash.	Willows (three spp.).	Ling.
Holly.	Honeysuckle.	Heaths (two spp.).
Hawthorn.	Bramble.	*Ulex Gallii*, Planch.

The arrangement of these elements varies from place to place. Here the taller trees and shrubs may be thickly clustered, there gorse; in other parts bilberry, heather, or bracken covers the ground. The herbaceous vegetation of the drier parts includes—

Viola Riviniana, Reich.	*Hieracium Pilosella*, L.	*Orchis maculata*, L.
Polygala serpyllacea, Weihe.	*H. vulgatum*, Fries.	*Habenaria conopsea*, Benth.
Hypericum pulchrum, L.	*Jasione montana*, L.	*Luzula campestris*, DC.
Potentilla sylvestris, Neck.	*Campanula rotundifolia*, L.	*Luzula erecta*, Desv.
Alchemilla vulgaris, L.	*Vaccinium Myrtillus*, L.	*Carex pilulifera*, L.
Pimpinella Saxifraga, L.	*Calluna Erica*, DC.	*Agrostis vulgaris*, With.
Galium saxatile, L.	*Erica cinerea*, L.	*Sieglingia decumbens*, Bernh.
Scabiosa Succisa, L.	*Pyrola media*, Sw. Rare.	*Festuca ovina*, L.
Solidago Virgaurea, L.	*Digitalis purpurea*, L.	*Pteris aquilina*, L.
Gnaphalium sylvaticum, L.	*Teucrium Scorodonia*, L.	*Lomaria Spicant*, Desv.
Centaurea nigra, L.	*Rumex Acetosella*, L.	*Lastræa Oreopteris*, Presl.

Clough Swamp.—Parts of the clough are wet, and support a larger number of moisture-loving plants than the upper moorland:—

Ranunculus Lenormandi, F. Schultz.
R. Flammula, L.
Viola palustris, L.
Lychnis Flos-cuculi, L.
Stellaria uliginosa, Murr.
Montia fontana, L.
Hypericum quadratum, Stok.
Lotus uliginosus, Schk.
Spiræa Ulmaria, L.
Drosera rotundifolia, L.
Callitriche stagnalis, Scop.
Hydrocotyle vulgaris, L.
Œnanthe crocata, L.
Galium Witheringii (Sm.).
Achillea Ptarmica, L.
Senecio aquaticus, Huds.
Cnicus palustris, Willd.
Crepis paludosa, Moench.
Lysimachia nemorum, L.
Myosotis cæspitosa, F. Sch.
M. palustris, Relh.
M. repens, G. Don.
Veronica Beccabunga, L.
Pinguicula vulgaris, L.
Scutellaria minor, Huds. Rare.
Orchis latifolia, L.
Narthecium Ossifragum, Huds.
Juncus conglomeratus, L.
J. lampocarpus, Ehrh.
J. acutifolius, Ehrh.
Potamogeton polygonifolius, Pour.
Scirpus setaceus, L.
Carex echinata, Murr.
C. Goodenowii, J. Gay.
C. lævigata, Sm.
C. pendula, Huds. Rare.
C. binervis, Sm.
C. fulva, Good. Rare.
C. flava, L. (var.).
Agrostis palustris, Huds.
Deschampsia cæspitosa, Beauv.
Holcus lanatus, L.
Equisetum limosum, Sm.
E. palustre, L.

Mosses, hepaticæ, and algæ are well represented.

Upland Oak Woods.—These extend from 500 feet to 1000 feet (152 to 300 metres). They occupy dry rocky slopes on the Millstone Grit area. The oak is usually dominant; but when the best of these trees are removed and no others planted, the birch becomes dominant, either alone or mixed with stunted oaks. There is reason to believe that before the expansion of the cultivated land to its present limits, the upland oak wood must have formed a well-marked zone of primitive forest, following the course of the valleys; but as disforesting has gone on without much attempt at replanting, the existing woods are only the meagre remains of this. Where replanting has been attempted, mixed plantations may occur on the site of the previous oak woods. In such cases the Scots and Austrian pines, spruce, larch (occasionally), sycamore, and beech are found in varying proportions; and all (except perhaps the larch) do well if suitable precautions are taken.

The loose canopy of the oak wood favours a thick undergrowth (Fig. 6), which, however, does not include a large number of species. This undergrowth may form a loose thicket of small shrubs. In less shaded parts the bilberry or bracken or grasses become dominant; while the rocky edges and open parts are not uncommonly covered with heather and some of its associates.

Lowland Oak Woods.—This name is given to what might equally well be called damp oak woods, or mixed deciduous woods. On the Millstone Grit, woods of this type are confined to the valley bottoms below an altitude of about 500 feet; but throughout the wider valleys and lower altitudes of the Coal Measures they are of greater extent. The woods seen in traversing the area by railway are usually of this kind. The oak is still a dominant tree, though the sycamore and

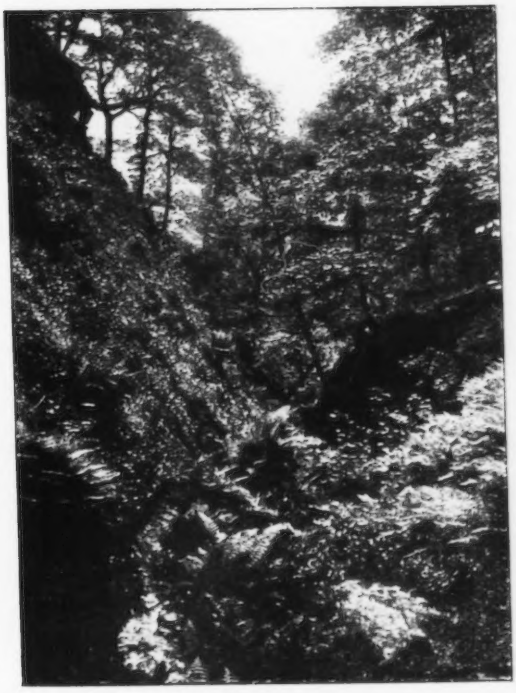


FIG. 8. Oak wood; in the Clough.

wych elm frequently share dominance. Ash, beech, and alder are less common, but still frequent; while horse-chestnut, sweet chestnut, poplars, the larger willows, and conifers, are occasionally planted. The best development of these oak woods occurs in the Dearne district around Barnsley.

The upland oak wood is usually dry and rocky, and deficient in humus: the lowland oak wood is damp, shaly, and richer in humus. The shade cast by the trees is much greater in the latter than in the former. Hence the flora of the latter is much richer in species, especially of the bulbous and early flowering kinds; while the flora of the upland oak wood contains a high proportion of late-flowering, moorland xerophytes, which are practically absent from the lowland oak wood. This difference is also observable in regard to mosses and liverworts. In order to facilitate comparison, the following full, but not exhaustive, lists are placed side by side:—

Upland Oak Wood.	Lowland Oak Wood.	
Trees.	*Trees.*	
Quercus Robur, L.	*Quercus Robur*, L.	*Ulmus montana*, Stokes.
Betula pubescens, Ehrh.	*Betula pubescens*, Ehrh.	*Prunus Avium*, L.
Pyrus Aucuparia, Ehrh.	*B. verrucosa*, Ehrh.	*P. Cerasus*, L.
Cratægus Oxyacantha, L.	*Fagus sylvatica*, L.	*Cratægus Oxyacantha*, L.
	Acer Pseudoplatanus, L.	*Alnus glutinosa*, Medic.
	Fraxinus excelsior, L.	*Salix fragilis*, L.
Shrubby Forms.	*Shrubby Forms.*	
Ilex Aquifolium, L.	*Ilex Aquifolium*, L.	*Hedera Helix*, L.
Corylus Avellana, L.	*Corylus Avellana*, L.	*Lonicera Periclymenum*, L.
Prunus spinosa, L.	*Acer campestre*, L.	*Sambucus nigra*, L.
P. Padus, L.	*Ulex europæus*, L.	*Viburnum Opulus*, L.
Rubus Lindleianus, Lees.	*Rubus idæus*, L.	*Solanum Dulcamara*, L.
R. radula, Weihe.	*R. Sprengelii*, Weihe.	*Salix Caprea*, L.
Rosa canina, L.	*Rosa arvensis*, Huds.	
Hedera Helix, L.		
Lonicera Periclymenum, L.		
Vaccinium Myrtillus, L.		
Calluna Erica, DC.		
Salix aurita, L.		
S. Caprea, L.		
S. repens, L. Rare.		
Herbaceous or Ground Forms.	*Herbaceous or Ground Forms.*	
Neckeria claviculata, N.E.Br.	*Anemone nemorosa*, L.	*Veronica Chamædrys*, L.
Lychnis dioica, L.	*Ranunculus repens*, L.	*V. montana*, L.
Hypericum pulchrum, L.	*R. Ficaria*, L.	*Lathræa Squamaria*, L.
Lathyrus montanus, Bernh.	*Caltha palustris*, L.	*Nepeta Glechoma*, Benth.
Potentilla sylvestris, Neck.	*Trollius europæus*, L. Local.	*Stachys Betonica*, Benth.
Epilobium angustifolium, L.	*Cardamine pratensis*, L.	*S. sylvatica*, L.
Galium saxatile, L.	*C. amara*, L.	*Galeopsis Tetrahit*, L.
Solidago Virgaurea, L.	*C. flexuosa*, With.	*Lamium Galeobdolon*, Cran.
Hieracium vulgatum, St.	*Viola Riviniana*, Reich.	*Ajuga reptans*, L.
	Lychnis dioica, L.	*Polygonum Bistorta*, L.

Herbaceous or Ground Forms.

Jasione montana, L.
Campanula rotundifolia, L.
Pyrola media, Sw. Rare.
P. minor, L. Rare.
Digitalis purpurea, L.
Melampyrum montanum, Johnst.
Teucrium Scorodonia, L.
Rumex Acetosella, L.
Luzula erecta, Desv.
Carex pilulifera, L.
Agrostis vulgaris, With.
Deschampsia flexuosa, Tr.
Holcus mollis, L.
Molinia varia, Schrank.
Melica uniflora, Retz.
Nardus stricta, L.
Pteris aquilina, L.
Lomaria Spicant, Desv.
Lastræa Oreopteris, Presl.
L. Filix-mas, Presl.
L. paleacea, Moore.
L. dilatata, Presl.

Herbaceous or Ground Forms.

Stellaria nemorum, L. Local.
S. Holostea, L.
Arenaria trinervia, L.
Geranium sylvaticum, L.
G. Robertianum, L.
Oxalis Acetosella, L.
Vicia sylvatica, L. Local.
V. sepium, L.
Spiræa Ulmaria, L.
Geum urbanum, L.
G. rivale, L.
Fragaria vesca, L.
Potentilla Fragariastrum, Ehrh.
Chrysosplenium oppositifolium, L.
C. alternifolium, L. Local.
Circæa lutetiana, L.
Sanicula europæa, L.
Conopodium denudatum, Koch.
Myrrhis Odorata, Scop.
Chærophyllum temulum, L.
Angelica sylvestris, L.
Heracleum Sphondylium, L.
Caucalis Anthriscus, Huds.
Galium Aparine, L.
Asperula odorata, L.
Valeriana sambucifolia, Willd.
V. dioica, L. Local.
Tussilago Farfara, L.
Petasites officinalis, Moench.
Arctium minus, Bernh.
Cnicus heterophyllus, Willd. Rare.
Lapsana communis, L.
Crepis paludosa, Moench.
Lactuca muralis, Fres.
Campanula latifolia, L. Rare.
Primula acaulis, L.
Lysimachia nemorum, L.
Myosotis palustris, Relh.
M. sylvatica, Hoffm.
Rumex viridis, Sibth.
R. Acetosa, L.
Mercurialis perennis, L.
Urtica dioica, L.
Neottia Nidus-avis, Rich. Rare.
Epipactis latifolia, All. Local.
Orchis mascula, L.
Narcissus Pseudo-narcissus, L.
Tamus communis, L.
Allium ursinum, L.
Scilla festalis, Sal.
Gagea fascicularis, Sal. Local.
Paris quadrifolia, L.
Juncus effusus, L.
Luzula vernalis, DC.
L. maxima, DC.
Carex remota, L.
C. pendula, Huds. Local.
C. sylvatica, Huds. Local.
C. lævigata, Sm.
Anthoxanthum odoratum, L.
Milium effusum, L.
Deschampsia cæspitosa, Beauv.
Melica uniflora, Retz.
Poa nemoralis, L. Rare.
P. pratensis, L.
Festuca sylvatica, Vill. Rare.
Bromus giganteus, L.
B. ramosus, Huds.
Brachypodium gracile, Beauv.
Athyrium Filix-fœmina, Roth.
Lastræa Filix-mas, Presl.
L. spinulosa, Presl.
L. dilatata, Presl.
Phegopteris Dryopteris. Fee. Rare.
P. polypodioides, Fee. Local.
Equisetum sylvaticum, L.

3. The Farmland, or Area of Cultivation.

This, with the woodland, includes all vegetation up to the limit of cultivation, and corresponds to H. C. Watson's Agrarian region. It is situated below 1250 feet (380 metres), except small isolated patches which occur up to nearly 1500 feet. On a reconstruction map like Flahault's, the greater part of the farmland would be regarded as enclosed from

the primitive forest, and included under one of the types of oak wood. Apart from the woodland, this area presents two distinct sub-types of vegetation—(1) uncultivated lands; (2) cultivated lands.

(1) Uncultivated Lands.—The area of cultivation has occasional patches of land which, never cultivated, have remained more or less primitive in character. Some of these are steep, rocky, or badly drained places belonging to the moor edge, unsuited for ploughing, and left island-like in the midst of cultivation; others are common grazing-grounds belonging to villages; others are wood-clearings never brought under the plough. Places of this kind deserve attention in a survey, because they give some evidence of the primitive vegetation of the district before agriculture displaced it. At the same time, human influences have affected them; they are generally used as grazing-grounds and are readily accessible to the plant-collector, hence too much weight cannot be laid on the evidence they offer. When of sufficient size to show on a map of this scale, the dominant vegetation of these areas is indicated by the colours used for grass, or heather, or mixtures of grass and heather. A special colour has been used to indicate lowland swamps with aquatic vegetation. In considering the uncultivated lands, we shall take them in the order of the geological areas, from west to east.

A. *Dry Heaths of the Millstone Grit Area.*—The uncultivated parts near the moorland may be recognized at once as vestiges of the primitive moor. The vegetation agrees closely with that already given as characteristic of grassy or heathery moor-edge. Away from the moorland, the heaths represent wood clearings, or a series of them may be correlated as remains of a larger moor or heath broken up by cultivation. An example of the latter occurs in the north-west corner of this map. It extends between the Wharfe and the Aire, from Otley Chevin south to Yeadon and east to Shadwell, near Leeds; it is a plateau of 800 feet altitude, declining southwards and eastwards to 500 feet. This area represents a former moor or moors known as Guiseley and Yeadon Moors, and Adel or Black Moor, a considerable tract of land which is now almost entirely under cultivation, and where wheat is grown up to 650 feet. Guiseley Moor now exists as a strip of heather vegetation along a road-bank above Otley Chevin, and as the warrens and coverts on the Chevin itself. The Black Moor at Adel extends from Meanwood Beck eastwards to near Wyke, Shadwell, and Roundhay, and on this area one may, within easy distance of Leeds, find several remnant patches of heath vegetation. The heath near Adel is shown by earlier lists of plants to have included almost all the species met with in the moor-edge vegetation; although at the present day only the common and more abundant remain, including three heaths, bilberry, gorse, and birch. These relics indicate the eastern end of a chain of moors of which the links, Rumbolds Moor and Barden Moor, are still wild

in character, and lead up to the Pennine mass of moorland. East of Adel, outliers of the Permian appear, and *Calluna* disappears. The most easterly occurrence of *Calluna* was found on the south side of Bramham Park, in the Permian area, but the *Calluna* itself is on an inlier of Millstone Grit.

The heaths found at lower altitudes are generally drained by streams whose banks support a vegetation which shows affinities with the clough swamp, the upper and lower oak zones, and the lowland swamp vegetation. The valley of the Meanwood Beck above Leeds may be taken as an example. The stream rises near Bramhope (600 feet) on what has been a moor, but is now farmland. At Adel Dam (400 feet) an artificial reservoir has become a swamp in which plants of the clough swamp and wet heath may be found with species of the lowland swamp. The stream from this place, till it enters the Coal Measures (about 200 feet), flows through a valley the banks of which present in succession grass heath with gorse and bracken; heath with heather, ericas, bilberry, and other associates; birch wood; alder and willow thicket; or oak woods more or less altered by introduced trees. Thus within a short excursion, almost all the types of the present map may be seen occupying limited areas. Mr. Lees (1880) gives a list of a hundred species in Meanwood valley, and this includes neither common plants nor many agricultural weeds which have become established. A zone of intermediate marsh vegetation is thus presented, and the following plants are characteristic. Some of them are found in the clough swamp, and almost all occur in the lowland aquatic vegetation.

Intermediate zone of marsh—

Nasturtium palustre, DC.
Cardamine amara, L.
C. pratensis, L.
Hypericum quadratum, Stokes.
Epilobium hirsutum, L.
E. obscurum, Schreb.
Hydrocotyle vulgaris, L.
Apium nodiflorum, Reichb.
Œnanthe crocata, L.
Galium Witheringi (Sm.).
Valeriana dioica, L.
Scrophularia nodosa, L.
Scutellaria galericulata, L.
Polygonum Hydropiper, L.
Polygonum amphibium, L.
Elodea canadensis, Michx.
Sparganium ramosum, Huds.
Lemna minor, L.
Alisma Plantago-aquatica, L.
Triglochin palustre, L.
Eleocharis palustris, R. Br.
Carex remota, L.
Phalaris arundinacea, L.
Equisetum palustre, L.

B. *The Coal Measure Common.*—This bears a strong resemblance to the Millstone Grit heath just described, and is quite distinct from the Permian common. It is as a rule distinguished by the rare occurrence of the plants of the *Calluna* heath, which are so frequent on the grit. Brierley Common, between Hemsworth and Cudworth, is the largest area of this kind, and other examples occur on the watersheds of the tributaries of the Dearne and Calder. The following list was taken

in July on Netherton Common, south of Wakefield, and shows the plants characteristic of such commons:—

Nardus stricta, L. Dominant.
Agrostis vulgaris, With. „
Festuca ovina, L. „
Anthoxanthum odoratum. „
Ulex europæus, L. „
Pteris aquilina, L. „
Hypericum pulchrum, L.
Lotus corniculatus, L.
Potentilla sylvestris, Neck.
Rubus fruticosus (subspp.).
Rosa, spp.
Cratægus Oxyacantha, L.
Galium saxatile, L.
Teucrium Scorodonia, L.
Ajuga reptans, L.
Holcus mollis, L.
Deschampsia cæspitosa, Beauv.

The hill known as Baildon common (927 feet), near Shipley, is another example. It is an outlier of the lower Coal Measures in the Millstone Grit. Its general grassy aspect at once distinguishes it from the dark heathery edges of Rumbolds moor, 2 miles off; a closer examination showed that it agrees with the list just given.

C. *The Permian Common.*—The Permian area is so much under cultivation that few uncultivated places are left. Disused quarries are common, and afford a refuge for a varied flora, generally with the character of a copse or thicket of ash and hazel. It is advisable to defer the description of the limestone vegetation till the next map of this series. On the present map, however, Hook Moor, near Aberford, is the best example of a primitive Permian grass moor met with in the survey of the West Riding. The vegetation is so different from any of the grass heaths already described that it is noteworthy:—

Brachypodium pinnatum, Beauv. Dominant.
Festuca ovina, L. Dominant.
F. rubra, L. „
Bromus erectus, Huds. „
Helianthemum Chamæcistus, Mill.
Viola odorata, L.
V. hirta, L.
V. silvestris, Reich.
Polygala vulgaris, L.
Euonymus europæus, L.
Rhamnus catharticus, L.
R. Frangula, L.
Ulex europæus, L.
Rubus idæus, L.
R. rusticanus, Merc.
Rubus cæsius, L.
Rosa spinosissima, L.
R. canina, L.
R. arvensis, Huds.
Bryonia dioica, Jacq.
Sambucus nigra, L. (wild type).
Asperula cynanchica, L.
Carlina vulgaris, L.
Primula veris, L.
Ligustrum vulgare, L. (wild type).
Gentiana Amarella, L.
Euphrasia officinalis, L.
Thymus Serpyllum, Fr.
Plantago media, L.
Tamus communis, L.
Pteris aquilina, L.

The character of this association places it under the vegetation which we distinguish as Natural Pasture (Pa.). Other examples on this map are similarly indicated, but the chief development occurs in Part II. of this survey.

Aquatic and Marsh Vegetation.—From the high moorland to the lowland there is an interesting change in the hydrophytic vegetation. The chief associations have been dealt with as they were found with

the types of drier vegetation, but it seems advisable to draw them together now. The course of any stream presents, in succession, the flat or gently sloping gathering grounds, the zone of rapid descent, and the zone of low gradient with slow currents. The extent of the three zones depends on the topography and geology of the country. In the present map, the marsh vegetation of the gathering grounds is somewhat varied, and is found in (1) the wet *Eriophorum* moor, (2) the wet parts of the heather moor, and (3) the *Molinia* or wet grass heath, all of which have already been referred to. The clough swamp is to be regarded as an accessory gathering-ground, where the waters of the moor are augmented by other springs exposed in the cutting back of the clough head. The clough swamp indicates a double change in the stream: the chief zone of rapid descent begins here, and the stream enters the woodland zone. Both changes have a distinct effect on the vegetation. The presence of alders, willows, and other trees favours the increase of shade-preferring plants, but the high altitude, with its severer climate, limits the number of species. The rapid drainage of this zone is not favourable to the formation of reaches of still water, hence the reed-swamp is not represented; but small marshes may form, and some moisture-loving marginal plants occur (Fig. 9). The intermediate zone of marsh vegetation (see p. 392) appears when the streams approach the Coal Measures, and form swampy areas favourable to the aquatic and marsh vegetation of the lowlands. The presence of numerous canals and reservoirs also brings the lowland vegetation up into this zone; this has been shown for the parish of Halifax by Mr. Crump (1901), and Mr. Moss (1900). The true lowland aquatic vegetation occurs in stagnant or slow-moving waters, either on the Coal Measures or on alluvial deposits of the rivers. The more important of these are indicated on the map, and include swampy marshes and subsidences due to coal-mining. The aquatic vegetation here considered is that of altitudes below 300 feet (90 metres). The area is entirely fresh-water, but plants of the maritime type begin to appear immediately to the east of the present map. Owing to extensive river pollution, the aquatic vegetation is inferior to that of the area north of this (see Part II.). The following may be found:—

I. Free-floating plants—

Utricularia vulgaris, L.
Ceratophyllum demersum, L. Rare.
Hydrocharis Morsus-ranæ, L.
Stratiotes Aloides, L. Rare.
Lemna minor, L.
L. trisulca, L.

II. Rooted plants with submerged or floating leaves—

Ranunculus aquatilis (*agg.*).
Hippuris vulgaris, L.
Myriophyllum alternifolium, DC.
Hottonia palustris, L.
Polygonum amphibium, L.
Potamogeton natans, L.
P. crispus, L.
P. pectinatus, L.
Zannichellia palustris, L.

FIG. 9. Oak wood. Clough stream with marginal vegetation.

III. Reed swamp; plants with elongated leaves—

Lythrum Salicaria, L.
Iris Pseudacorus, L.
Typha latifolia, L.
Sparganium ramosum, Huds.
S. simplex, Huds.
Acorus Calamus, L.
Alisma Plantago-aquatica, L.
Sagittaria sagittifolia, L.
Butomus umbellatus, L.
Phragmites communis, Trin.
Glyceria aquatica, Sm.
Equisetum limosum, Sm.
E. palustre, L.
E. maximum, Lam.

IV. Marginal plants of the marsh (see also p. 388)—

Ranunculus sceleratus, L.
Caltha palustris, L.
Nasturtium amphibium, R.Br.
Barbarea vulgaris, R.Br.
Epilobium hirsutum, L.
Sium erectum, Huds.
Œnanthe Phellandrium, Lam.
Bidens tripartita, L.
Lysimachia vulgaris, L.
Scrophularia aquatica, L.
Lycopus europæus, L.
Stachys palustris, L.
Carex acuta, L.
C. riparia, Curt.

The algæ have been recorded by Mr. W. West, of Bradford (1902).

(2) CULTIVATED LAND.—The crops grown on the farmland indicate its capacity in regard to vegetation. The Board of Agriculture returns (1901) of the crops of the whole West Riding (of which the present map includes nearly one-third) are—

Corn crops	Wheat	42,092	acres.
	Barley or bere	57,483	„
	Oats	75,874	„
	Rye	2,136	„
	Beans and peas	6,997	„
		184,582	„
Green crops	Potatoes	27,711	„
	Turnips and swedes	50,647	„
	Mangold	7,488	„
	Cabbage, vetches, etc.	8,063	„
		93,909	„
Clover, sainfoin, and grasses under rotation.	For hay	50,680	„
	Not for hay	29,692	„
		80,372	„
Permanent pasture, or grass not broken up in rotation, and not including mountain and heath land.	For hay	260,636	„
	Not for hay	566,507	„
		827,143	„

On the eastern lowlands and in the wide valleys of the Coal Measures, the farm rotations include all the crops given above. As the altitude increases towards the west, the cultivation of mangold, wheat, and the finer barleys gradually ceases, till on the upland farms the only crops of the ploughed land are oats, turnips, and the hardy bere (barley). At present the western part is almost entirely grass-land, and ploughed fields are only occasionally found. The farmland on the vegetation map is subdivided into a lower or wheat zone, and an upper or "no wheat" zone. Wheat is here taken as an indicator-plant, because it is already recognized as such in existing vegetation maps. Our wheat zone

represents in Britain the warmer parts of Central Europe. The area of the possible cultivation of wheat in Britain presents an interesting problem in plant distribution, because we have a gradual reduction of the area from south to north, and a well-marked limit in altitude. The restricted distribution does not appear to depend on soils alone, and one must look more to climatic factors as determining its range. The recording of the upper limit on these maps furnishes material for examining what the conditions really are. The problem, however, is one for special consideration, with the assistance of experienced meteorologists. The most important climatic condition required for the successful ripening of wheat is a hot summer relatively dry, and this can only be obtained where the rainfall is low. The rainfall and the average summer heat of a district are therefore determining factors. Since wheat is generally sown in autumn, and the young plants pass through the winter, the climatic conditions of that period must also have an influence. Dr. Herbertson, who has kindly assisted us in this matter, summarizes the necessary conditions as a function of (1) sunshine, (2) temperature, (3) moisture, (4) rainfall, (5) ground water-supply, during the whole growth-period. The climatology of Yorkshire in its relation to the distribution of various plants has been suggestively, but in a general way, discussed both by Mr. Lees (1888) and Mr. Baker (1885). Dr. Buchan (1862) gives 56° Fahr. (13° C.) as the average summer temperature required for the ripening of wheat in Scotland. In the Edinburgh district, R. Smith (1900) gives tables showing the mean July temperature and the rainfall at various stations. It appears from these that wheat ceases to be a regular crop of the farm at an altitude where the mean July temperature is below 56° Fahr. and the rainfall exceeds 32 to 33 inches per annum. Summarizing the rainfall in the present map, Dr. H. R. Mill says, "It is under 30 inches (76 cms.) east of a line through Pudsey, Cleckheaton, and Cawthorne: a roughly parallel line at from 5 to 8 miles westwards indicates the beginning of rainfalls over 46 inches, except in the valley of the Aire, where it is between 30 and 40 inches." The following table gives data:—

	Altitude.	Mean annual rainfall.	Zone of vegetation.
	Feet.	Inches.	
South Milford	70	26	
Wath-upon-Dearne	188	26	Wheat.
Bradford	366	30	
Leeds (Allerton Hall)	418	28	
Halifax (Bellevue)	625	33	Near limit.
„ (Ramsden Wood)	815	37	
„ (Ogden)	990	43·5	
Moors	1050–1380	47	No wheat.
Woodhead Reservoir	660	49	
Rawtenstall, Clough Bridge	900	49	

The mean July temperature at Bradford, at 366 feet (*Y.N.U. Trans.*, 1900), is given as 59°·5 Fahr. (adopted mean for twenty-eight years). Mr. Crump (1901) gives statistics from two stations at Halifax; one at 526 feet gives the average from June to August as about 59° Fahr., another at 625 feet gives 56° Fahr. for the same period. From the maps in the volume on meteorology of Bartholomew's Physical Atlas (1899), it is fairly safe to assume that in the present area up to 900 feet (273 metres) the mean temperature for July is over 56° Fahr. (13° C.). The evidence for Yorkshire therefore supports the Scottish results—that throughout the wheat zone indicated on the map the average July temperature is at least 56° Fahr., and the rainfall is below 33 inches. In considering the woodland, we have already pointed out that the oak woods below about 500 feet (that is, within the wheat zone) have a type of vegetation richer in species than the upper oak belt. The patches of uncultivated land found within the wheat zone are too few to allow of any definite conclusions, yet they also present a more varied vegetation than the upland moors. In the farmland the upper and lower zones are recognized, not only by the crops, but also by the weeds of cultivation and the vegetation of the cultivated grass-land. The aquatic vegetation of the lowlands is also much richer in species than the "no wheat" zones.

The determination of a precise line to indicate the upper limit of the wheat area is rendered difficult at the present time by certain economic conditions. The declining price of wheat for many years has led to a marked shrinkage in the acreage devoted to it, and to an increase in grass-land. The returns of the Board of Agriculture (1891) for the whole West Riding show this:—

	Acres.		
1871	103,910	90 acres	per 1000 acres of cultivated land (not including nurseries, woods, or unenclosed moor or heath).
1881	75,142	63 „	
1891	58,614	48 „	
1901	42,092	—	

The reduction of wheat cultivation is evident over the whole area, but is most marked (1) in the vicinity of towns and manufacturing districts, where the conditions for growth are less favourable, and where dairy farming or market gardening is more profitable; (2) on poor, especially light, lands, which are unfavourable to the winter growth of autumn-sown wheat; (3) towards the upper limits of the wheat zone. The last-mentioned area of shrinkage is the most important for this survey, because it affects the determination of the upper limit of wheat. During the progress of the survey, wheat has always been recorded on the field maps, either from observation or from reliable information. In some districts it has been ascertained that wheat was grown, but the crop was uncertain, ripening only in favourable seasons; in other words, its upper limit was ascertained. On the map the letter "W"

above 500 feet (152 metres) indicates an actual observation on that spot, and the line defining the lower zone of cultivation from the upper is drawn from an average of these upper records. The average height of this line is from 600 to 700 feet, declining in the narrow western valleys to 400 feet. In the survey of the Edinburgh district, R. Smith fixed the wheat limit at 500 feet on northern exposures, rising to 700 feet on southern.

A transition zone between wheat and no-wheat was considered necessary to represent certain areas where wheat is now found occasionally over 700 feet, and was formerly grown to a larger extent. From the economic aspect of the present day, these transition areas cannot be considered as wheat-producing, but from the point of view of plant-geography it is necessary to indicate on the map that wheat may be grown there. The transition area occurs at an altitude of 800 to 1000 feet, near the junction of the Millstone Grit and lower Coal Measures. The Coal Measure valleys are wide, with gentle slopes, rising to comparatively low watersheds; these conditions are favourable for the cultivation of wheat, as our records show, up to the watershed. West of the Holme valley the transition area occurs on gentle slopes on the Millstone Grit, *e.g.* Honley Moor. It is noteworthy that this transition zone occurs on or about the rainfall line of 30 inches. In general aspect the vegetation of this zone is poor in species, and has more affinity with that of the no-wheat and moor-edge areas than with the true wheat zone. We therefore considered it advisable to represent it as shown on the map. In a more detailed survey, using maps on a larger scale and taking the underlying soils into consideration, the vegetation of the cultivated farm lands would be better represented by further subdivision. Such a survey would require careful investigation, and could be undertaken only by those having access to returns of crops, such as are furnished annually to the Board of Agriculture.

The weeds of arable land are chiefly annuals, many of which also occur in gardens or other freshly turned land. The greatest variety of weeds is found at low altitudes and in the richer land of the wheat zone; with increasing altitude many of the species cease to be prominent weeds and become casuals. The practice of using seed grain imported from a new district aids in spreading weeds, hence lowland species may be recorded occasionally at higher altitudes than usual, but they soon die out unless suited to the locality. A list of eighty-four weeds of arable land in Yorkshire, when arranged according to the altitudes given by Lees (1888), show about forty-four occurring above the wheat line; but these altitudes are the range of the species, not its range as a weed, which is generally lower. In a list of "One Hundred Yorkshire Weeds," compiled by us for the Agricultural Department of the Yorkshire College, sixty-three are common weeds of arable land; and

of these not more than forty-two occur above the wheat line. The following is a short list of characteristic species :—

Chiefly in Wheat Zone.	In Both Zones.
Papaver Rhœas, L.	*Bursa Bursa-pastoris*, Web.
Raphanus Raphanistrum, L.	*Brassica Sinapistrum*, Boiss.
Viola arvensis, Murr.	*Viola tricolor*, L.
Lychnis Githago, Scop.	*Stellaria media*, Cyr.
Æthusa Cynapium, L.	*Spergula arvensis*, L.
Scandix Pecten-Veneris, L.	*Matricaria inodora*, L.
Matricaria Chamomilla, L.	*Tussilago Farfara*, L.
Chrysanthemum segetum, L.	*Senecio vulgaris*, L.
Sonchus arvensis, L.	*Sonchus asper*, Hoffm.
Chenopodium album, L.	*Atriplex patula*, L.
Polygonum Convolvulus, L.	*Polygonum aviculare*, L.
Euphorbia exigua, L.	*Euphorbia Peplus*, L.

Grass-land.—A large proportion of the farm-land is now left permanently as grass, but almost every field shows the ridges and furrows left on land which has been ploughed. In reclaiming the land from moor or heath, it is usual to enclose and plough it, and after taking one or more crops from it, to sow down with grasses. Many of the fields in the upper zone have probably only been once ploughed, but generally the land has been broken up oftener. The grass-land of the no-wheat zone of the western uplands is, as a rule, poorly cultivated. The mixed herbage yields one crop of hay each summer, and is then grazed till winter. In spring, the manure from stables and yards is distributed over the fields, and beyond this, little manuring takes place. On some farms, lime is applied at intervals of a few years, and on this soil, consisting chiefly of sands and shales, the beneficial result on the herbage is very marked.

In the eastern lowland part of the map, over the Coal Measures, more land is regularly ploughed, but a considerable acreage is permanently grass. Some of the grass-fields are used only for grazing: others are reserved for meadow hay. The meadows yield one or two crops of hay annually, and are well manured to encourage the larger grasses. Sward-forming grasses are preferred on the pastures. In regard to the numerous associates of the grasses which together make up the sward of a pasture or meadow, we have compared their range of distribution, and find that a considerable proportion cease at about 600 feet, others at 900 feet, while the rest ascend to altitudes above 1250 feet.

The pastures and meadows overlying the Permian limestone have a characteristic vegetation. In early summer especially, their bright green colour contrasts strongly with the dull green of pasture on adjoining formations. The constituents of the Permian vegetation are reserved for Part II. of this survey.

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FROM QUITO TO THE AMAZON VIÂ THE RIVER NAPO.

By A. HAMILTON RICE, B.A., F.R.G.S.

ON August 12, 1901, after the usual delay incidental to the departure upon every journey in South America, either for small distances or great, five miserable specimens of animals, claimed to be horses and mules, two arrieros, my negro servant and I turned our backs upon Quito, bound for the Indian village of Papallacta, two days distant. Mr. Söderström, the English consul, who had been my friend and benefactor in every possible way during my stay in Quito, accompanied us out of the city some 4 miles, bidding me God-speed, near the crumbling church dedicated to the Virgin of Guadeloupe, which marks the village of Guapulo. There is a fair road, first through the hills and then upon the open, with signs on all sides of Cotopaxi's violence, to the fever-infested and lifeless village of Tumbaco, where it is said no stranger can pass the night without contracting severe fever; and its hygienic conditions may be judged by the fact that its enterprising inhabitants let their dead remain unburied for days, never removing them from the huts, the natural decomposition process being aided by flocks of the carrion crow, or *gallinazo*, so called. Here some change of beasts was made, and the number increased from five to six, as the road was reported to be in bad condition—bad in Ecuador would be execrable, if not impassable, elsewhere.

The trail from Tumbaco is a sandy one, through a dreary country of a monotonously undulating character, with a stream to be crossed which reaches the flanks of the animals. About sunset, shortly after getting into the hills, the low rambling buildings of the *hacienda* Itulcachi appeared in view, and in a short time we were past the heavy gateway, and in the spacious courtyard the Indian retainers in a leisurely way helped the arrieros to unpack the loads, while a tall, big-limbed young fellow went to summon the master in charge. He soon appeared, a typical Ecuadorian, in a large, high-pointed, broad-rimmed hat, a serviceable poncho, wide trousers, and big spurs; he accorded me a hearty welcome, extending both hands to grasp mine, and the look of cordiality and good feeling which overspread his lean, leathery, and bronzed countenance more than made up for the words he wished to

utter, for we did not understand each other's language. Evidently Itulcachi is experiencing more prosperity under the sway of Señor Don José Madrid than it did at the period when Orton described his night there. A splendid feast was prepared in my honour, to which only Señor Madrid and myself sat down, eating with our hats on, as is the custom, and served by several Indian women, one of whom had her baby strapped to her back, the infant sleeping peacefully meanwhile. In addition to the bottles of wine with which the table was loaded, bowls of delicious milk were brought in answer to my query of "leche," proving that the milk-producing qualities of the Itulcachi herds have increased in proportion with the general prosperity. One also had for the last time the luxury of a bed, and a wash-basin and jug to look at, presumably for ornament, as they were covered with dust, and served no practical use for ablution.

We made a fairly early start the next morning, with the whole household assembled to see us off, and loaded with presents of wine and food from the hospitable señor. The trail began abruptly upward, rough and uneven. Looking back, the hacienda with its innumerable cattle lay far below us. The day at first promised fine, but rain, thick driving mists, and a cold wind succeeded the sunshine as we ascended towards the summit. The trail is in many places obliterated, and at times difficult for the ill-conditioned beasts, who plainly showed signs of weariness. The arrieros were indefatigable in their efforts to drive them up the steep slopes, persuading, threatening with the voice, and lashing with stout-thong whips until the poor animals' exposed sides and hams were covered with weals from the severe and continuous flogging. Some two hours after noon the summit was crossed; from here to Papallacta it is a steady descent. I could discover no signs of a trail, simply a seemingly endless succession of bog and morass, in which the animals wallowed and floundered, or slippery slopes down which they glissaded. Some held their feet, others went like grain-bags down a shute. Several times it was necessary to dismount to get across the mud-holes, the beasts emerging on the other side miserable objects covered with the filthy mud, which reached above their hind-quarters. The stamina of the mules was in marked contrast to the horses, decidedly in favour of the mules. They were stronger in bearing weight, their endurance greater, their intelligence and willingness far more exemplified, nor did their small hoofs and legs sink so deep into the mire. Several times the horses fell and wearied themselves further, in their weakened condition, by their ineffectual attempts to regain their feet.

Papallacta was reached about 5 p.m., a hamlet of some twenty-five or thirty huts situated in the bottom of a deep bowl-shaped valley, which accounts for the gloom which oppresses one. The yapping of a dog was the only sign of life as we wound our way past the shacks to

the governor-general's palace, a substantial edifice of the hut order consisting of a stout frame of logs, with a finish of mud-plastering and a thatched roof. The governor, attired in a pair of drawers reaching halfway down his thighs and a ragged poncho, received me affably, making his house over to me for the time being, with the exception of a small portion of one end reserved for his family. The furnishing of the house further proclaimed him a man of simple tastes. Three stones on the ground, between which a fire was built, constituted the fireplace and stove; one iron and twice as many copper pots, several trenchers, bowls, and spoons hewn from wood, with two flat stones of unequal size for grinding corn, a primitive mill which was being industriously worked by a dusky young woman, completed the culinary articles. Several logs of varying circumference, over which was thrown a skin, as bed, and a round hollowed piece of board with three legs of unequal length, like an uneven milking-stool, made up the luxuries of furniture.

The Papallactans are a very short people: many of the men do not stand 5 feet high, and the women considerably less; 4 feet would be a good height, and a few inches under this is common. The men are thick-set, with enormous development of calf and thigh muscles, slender wrists and small hands, thick ankles and large triangular-shaped feet. The women are slender, ill-nourished and wizened, though some of the younger females possessed good features and comely countenances. Their dress consists in most cases of a strip of blue *lienza* cloth fastened round the loins, reaching to the knees, and necklaces made from old Spanish coins, with drilled holes and a cord passed through. The men in most cases, in addition to the loin-cloth, carry a poncho. The hair of both sexes is straight, black, coarse, and the skin a decided brown. The male skull is relatively and actually large, prognathism not marked. In the normal human being the femur is the longest bone in the body, but in several of the males whom I measured, taking the great trochanter of the femur and measuring to the external condyle, and making allowance for the difference between tuberosity and head, then measuring tibia from internal condyle to internal malleolus, the tibia was a trifle the longer.*

On the morning following my arrival, long before daylight, the accommodating governor-general was astir, asking for a few centavos that he might obtain for me some eggs and milk for breakfast. After an early meal, a much-wizened female appeared with a gift of fruit. Small and round, it resembled externally a miniature orange; inside it

* It is remarkable that here, in the north-east corner of Ecuador, a people exists similarly proportioned to the Aymara race living on the Titicaca tableland, of whom David Forbes, in his 'Aymara Indians,' says, "Instead of the thigh being, as in all other known nations, longer than the leg, it would appear to be, on the contrary, slightly shorter."

was of a soft pulpy consistency, with a tremendous number of seeds. The native way of eating appeared the most practical—to bite out a piece of the skin, devouring the contents much in the same way as a small boy sucks an orange.

The woman was followed by two of the three principal magistrates of the village, termed judges, one municipal and the other a one-eyed individual styled "the judicial," so my host informed my negro servant Tino, who performed the very important office of interpreter, speaking both Spanish and English fluently. The judges gravely shook hands with me, adding something in Quichua. To the governor-general, who understood Spanish, but could not read, Tino, in an impressive voice befitting the solemnity of the occasion, read the government documents which Señor Moncayo, Secretary of the Interior, had given me before I left Quito. The governor listened with rapt attention, interrupting only to put into Quichua, so that the others might comprehend its import. The men who were to be my porters began to arrive one by one. Each received five *sucres* (roughly about ten shillings) in small silver pieces, the usual price as named in the document I brought for performing the journey from Papallacta to Archidona. Each portion was gravely counted out and handed over by the governor. Before leaving Guayaquil I provided myself with £15, in coin of ten and five centavos value, which I found very useful in the interior, the natives having a decided liking for it, utterly disdaining the paper money.

The business transaction took up most of the day, becoming a town meeting, all the women and children assembling to listen and have a word. First it was declared by all impossible to start for two days, but when the *chicha*, which had been brought from Quito, was circulated freely, and a jack-knife apiece offered to the men as an extra inducement, they decided to go on the morrow. Each man selected the articles which were to make up his pack, the customary weight for a peon being three arrobas, or 75 lbs.

Next morning the governor's house presented a scene of bustle, women helping their husbands do up their packs, or drawing them aside for farewell messages and last words. Each peon carried a strong stiff rod of 6 feet length, packs fastened to their backs by means of portage straps made of strong strips of bark—one carried across the forehead, a second passed over the arms and around the chest. Some used a form of wicker basket lined with big green leaves, designed to keep the food and other perishable articles dry.

The one-eyed judge, with considerable manner, escorted me to the small meadow behind the governor's house, where the Archidona trail begins; the peons, following, gathered in a circle, drove their staffs into the ground, at which the women set up a wail, the men giving a weird chant-like answer. Felipe, the leader, was an intelligent man, with

whom further acquaintance bred respect and admiration. The governor at the last moment decided to go as far as Baeza, the present of a flannel shirt and an old saddle influencing him much in my favour. A mere slip of a girl accompanied the men, bearing on her back a load of 35 lbs.

The trail strikes immediately into the forest, and is a muddy, slippery, uneven one from the very first. It leads in an easterly direction along the left bank of a stream, into whose waters we were forced from time to time on account of the impenetrable denseness of the thicket growth. In the course of the day's journey, eight Indians from Archidona glided silently past, more after the manner of spectres than human beings, disappearing in the forest gloom as suddenly as they had come. They were of taller stature, more slender build, more lithe action and graceful movement than the Papallactans, destitute of all covering except a narrow breech-clout, their long black hair falling down upon their shoulders, whereas the Papallacta men wore theirs cropped short. From time to time the human train halted for a respite, fifty minutes to an hour being the stretch a peon could go with from 60 to 75 lbs. upon his back without stopping for rest, food, or drink, over one of the roughest, hardest routes of the world, a passage through which man forces himself, combating at every turn all obstacles that it seems possible Nature can throw in the way of his advance. Camp was struck at four o'clock, advantage being taken of a previously erected palm-leaf roofed shelter, a simple construction which any Indian erects in a few minutes—two forked poles placed upright, with a connecting ridge pole, against which a number of sticks are leaned; over these they dexterously weave a waterproof roof of big palm leaves as protection against the almost inevitable nightly shower. An animal was brought in a little smaller than a badger. Felipe called it a wild guinea-pig. Everything was devoured (*bestia fœmenei generis fuit et gravidas*), and all with a rapaciousness which left no doubt in one's mind as to their appreciation of such delicacies. The beast was caught in a trap of simple contrivance.

Early next morning saw the departure of the little girl back to Papallacta, a pack of large wooden trenchers strapped to her back—freight which had been waiting at this spot for transportation for some time—and our advance along a path more difficult than the first day. We still clung to the left bank of the stream, known as the Maspa, the trail ascending and descending along the steep sides of densely wooded hills, down whose slopes innumerable water-threads trickled, making the path treacherously slippery with a slimy mud. The raucous cataracts falling over cliffs washed portions of the path away, leaving no foothold, yet the manner in which the Indians threaded, picked, fought their way, cumbered as they were with their heavy packs, excited deepest admiration. At one point for some distance

landslides obliterate the path; the bank formed is excessively steep, composed of loose rolling stones and scree. With each foothold the mass gives way, rolling and tumbling down into the whirlpools and eddies of the swift, roaring river beneath.

At 2 p.m. an Indian hut in a little clearing was reached; at the same time four Archidona Indians glided past in their noiseless adder-like fashion. At this spot, to which Orton ascribes the name Pachamama, the night was passed, one uncomfortable for me on account of the unusual interest my head and body proved to the innumerable guinea-pigs which infested the dwelling, literally swarming over the floor and my bed of rushes. The governor decided suddenly he would not proceed to Baeza, and two others of the peons having become in a certain degree adynamic, the governor procured for me three fresh peons, who put in an appearance in the morning, accompanied by a most cowed, miserable, mangy, yellow dog. Of all who had a hard time on the journey, the dog's lot was certainly the worst, half drowned in the rivers, starved, lacerated, at times in imminent danger of losing its life in the mud; it was still, however, in the bedraggled procession which five days later straggled into Archidona. The third day the paths continued the same for six hours, rough or mud sloughs, and, the hillsides being steep, one's left leg was always at a greater elevation than the right; all efforts to keep an equilibrium were unavailing, every few yards meaning a fall—great clods of mud adhered to one's boots, greasing them in a treacherous manner, upsetting the negro and myself again and again. The Indians in their bare feet fared decidedly better.

By two o'clock a bridge of the cantilever type was reached, a rude though ingenious feat of engineering, consisting of three very long logs lashed together, and of these there are three parts. The two pieces which extend from either shore to support the midstream portion are held in position by the weight of a huge pile of rocks in such a manner that the logs are elevated at a steep angle, the central portion of the bridge being considerably raised above the river. The bridge sways and swings in anything but a reassuring way, and only one man may cross at a time, a slip or any other accident meaning certain death, for none but a lunatic could ever have hope of being saved, once hurled into the mad rush of the rapids and boiling cauldrons of whirlpools which now characterized the stream. It rushes along with terrific force, undermining the hills on either side, and before reaching the bridge, on the left bank is the result of what has been a very severe and extensive landslip, awful now to behold in its quiescent devastation. Huge masses of *débris*, great rock, enormous trunks of trees twisted inextricably, torn, rent asunder, and piled high in the most distorted and contorted manner, forming a barrier passable only by the generous use of machetes. In the upturned soil a dwarf vegetation in some

places fights for a place, and hundreds of turbulent little streams run down the slopes, but these signs of growth and activity fail utterly to shake off the awed feelings created by so eerie a scene of violence and desolation.

After crossing the bridge, it is a two hours' hard pull, the greater part up a steep hill, with every step one's feet seeming to go a bit deeper in the black soft mud before Baeza is reached. This settlement consists of a few huts inhabited by Indians, at the largest of which it is customary for the traveller to accept hospitality, such as it is. Baeza seems wrongly located on Wolf's map of the Oriente. He has placed it to the north-east of Pepallacta, yet the trail from thence runs east, varying sometimes to a southerly direction. Orton has done the same; I do not think it is so far north. From Baeza the trail ascends straight up the side of a hill, from the summit of which the first expansive view is obtained of the forest-covered mountains to the east, north, and south. They run in no regular series, but are closely packed, and none rises above timber line.

Descending the southern slope, the really bad part of the trail commences—endless successions of swamps; one is plunged over knee-deep in the bog earth and slimy filth of ooze-like mud, whose monotony is varied by pools of stagnant, foul-smelling water, into which I went twice waist-deep in the vain endeavour to keep my balance on the narrow sunken logs, which in some places are submerged, serving as extra difficulties to overcome. There is no possibility of getting round the mud-holes and sloughs by *détours* or flank movements, the forest being dense and overgrown with such impenetrable vegetation as to successfully defy attempts of any sort. From many of the tree-trunks project sharp, needle-like spines, which tear any clothing they may happen to catch, and lacerate the hands of those unfortunates whose minds, for the moment forgetful, worried, and exhausted by the miry sea of perplexities and difficulties, instinctively reach out to grasp the trunks in order to save themselves. This sort of thing lasts for two days; then the trail improves slightly again. It is discouraging, heartrending, suffering work; through it all one wonders how the peons ever got on, burdened with their heavy packs, pitiful specimens of humanity, with their stertorous breathing, bodies and limbs smeared and bedaubed with mud. Rain fell at frequent intervals, contributing to the general gloom.

Late in the day the Cosanga river was reached; camp was made on the left bank. Next morning we continued up the left bank for three hours, wading innumerable brooks, and following the devious windings to a spot where the river may be most easily forded. One Indian, the sturdiest of them all, was bowled over in the current, and of course it must needs be he who carried the camera; fortunately, not much damage was done. From here, for two hours, comes the worst stretch

of the whole journey, then the ascent of the Guacanayo ridge, whose sides and summit are clothed with a dense growth of timber, except where destructive landslides interrupt the wooded continuity. At times the summit is reported to be buried in snow, waist-deep, when progress, of necessity, becomes delayed. In the descent, the path is literally tunnelled in places, gouged out by mountain torrents and roofed in by fallen trees. The hard rains rendered any fire impossible, and clothes and boots, mud-soaked and drenched, remained in that condition till Archidona was reached the afternoon of the seventh day.

On the sixth day we met eight Indians coming from Archidona, from one of whom I obtained three lemons and a plantain, great delicacies after a diet of chocolate and barley-meal water. By noon we reached and crossed the Cochachimbamba, not without some difficulty, for while the river is much narrower than the Cosanga, it is deeper, the bottom more treacherous, and the current very swift. A change in the size and luxuriance of vegetable life begins to assert itself; tall trees rear themselves proudly above the rank profusion of tropical plants, beautiful in outline and grace of conformation when not disguised by the reticulated, inextricable substance of countless vines and spar-like lianas.

For the last 10 miles before Archidona is reached the path becomes uncomfortably narrow, the slippery yellow mud forming no foothold, and it is with a sigh of relief that the cane and banana groves are beheld, and the sense of having at last arrived is experienced. The governor-general, Señor Zapata, the chief executive of the Oriente, came to meet me and escort me to the Government House, a ramshackle affair of split bamboo, where he and several of the other government officials reside. Our arrival occasioned a momentary excitement, and the entire white population, consisting of some dozen men, officials and traders, came running over to see who it might be. None of them knew a word of English. The peons were immediately taken in charge by friends, and the yells and shouts of the drunken orgy held in their honour lasted till far into the night. Under the administration of President Alfaro, some radical changes have been effected, one of which has been the banishment of the Jesuits from the Oriente, and their authority in regard to the religious welfare of the Indians invested with the governor. Zapata, a young man of some energy, has gone so far as to build a church of the *corral* order of architecture, but just how and at what time use shall be made of it is not as yet decided; on Sunday mornings, when the full population of Archidona assemble 500 strong, they are put to work clearing land which Zapata is anxious to bring under cultivation; and the regular thing in the sabbath afternoon is to get as drunk as possible.

Concerning the natives, the men are tall, some 6 feet, well proportioned, and very muscular; several resembled the Greek idea

of physical beauty as regards torso and limbs. They wear the hair long, completely covering the ears and clipped off square over the forehead, which gives them a wild appearance. They paint their faces with a red pigment, the prevailing style being three lines drawn obliquely from a point just below the inner canthus across the cheeks, sometimes a line carried over the nose, and the grotesque effect further elaborated by a great daub all around the mouth. There is considerable variation, however, among them as regards physical type, for in addition to the aforementioned are those of a slender, lithe build, others of a burly appearance, rendered so by marked enlargement of the abdomen; especially was the protruding belly noticeable among all the very young children I saw on the Napo. It is said they swell themselves up by eating earth, which all the Indian children do. Some of the men's faces and bodies were covered with melasmic spots, varying from the size of a shilling piece to splashes. The women for the most part are small, round-shouldered, shy creatures; from their demeanour and general actions there would be no hesitation in assuming they occupied an inferior position. At meals they serve the men, afterwards eating what may remain. Both sexes have a fondness for necklaces composed of small glass beads, and some, of an æsthetic turn, make for themselves neck-bands of ingenious and pretty design. Some of the male dandies had sticks of bamboo inserted into their ears, protruding upward and out beyond their faces for some inches. The colour of these individuals is not a dark red, as Orton states, but a brown hue.

There has been in some men's minds the idea that the native of South America was of the stock, or closely allied to the race or family, of which the Japanese and Filipino form a part. It is claimed that, in the very young of these, two pigmentation spots are to be seen in the lumbar region on either side of the spine, which, however, disappear in the course of months or a few years after birth. Carefully examining every infant of from a few hours to two years of age that could be found from Guayaquil to the Amazon, in every case there was not the slightest trace of such markings to be found.

My idea, formed from reading Orton, of the apathy and laconicism of the Napo aborigines was rudely dispelled by a tremendous row and wordy warfare which took place on an early Sunday afternoon between the governor and several Indians. Any doubts as to whether these Indians are capable of speaking long sentences were completely dispelled, and they showed themselves capable of powerful and forcible argument, intonating in a loud, stammering, guttural way. They also at times exhibited great curiosity,* a camera, a watch, or a gun exciting

* Every one in Archidona is curious. The whites would never let me dress alone and daily rummaged through my packs and effects, being ably seconded by the Indians. Any attempt to do writing was entirely futile.

intense interest. They do a little hunting, more fishing (fishing is done in every case by very skilfully weaved, neatly executed nets), and considerable drinking, women being the drudges who perform the work. A sitting posture as known to us they never indulge in, but invariably squat upon their haunches. The chiefs carry long silver-headed canes and wear red caps and little red coats, which, with their loin-cloths, complete the sum total of wearing apparel. The principal duty of these notables seems to be directed toward large consumption of *chicha* and to remain in a chronic state of bibulous conviviality.

From Archidona to Napo it is six hours over a good trail, with two rivers to ford. The Jesuit church is in ruins, and there is an air of desertion about the place, most of the Indians having migrated elsewhere. It is here that one George Edwards, an American, interestingly mentioned by Orton, was foully murdered in 1896, concerning whose death no action was ever taken. Edwards, soon after the American Civil War, went to Ecuador and settled in the wilderness. He was held in high esteem by the Indians for his fair-mindedness, honourable dealings, and upright qualities. To within a few months of his death he had the companionship of a dog, but that friend dying, and the old man realizing that his years were telling on him, had determined to leave the wilderness which had been his home for so long and return to his native New England. Voluntarily he had resigned himself to this isolated spot, wore his hair hanging long upon his shoulders, and surrounded by his pets, tamed animals and birds from the forest, he existed in true Crusoe style. Reports had been brought across the mountains by Indians concerning the hoard of gold Edwards had accumulated in his twenty-five years of residence, and vague rumours along the coast from Guayaquil to Panama reached the ears of two Portuguese. One of these, a stranger to residents of Quito, penetrated into the Oriente, shortly returning to the coast to join his companion, and upon him is supposed to rest the guilt, the double crime of arson and murder. The charred ruins of Edwards's house, a little removed from Napo village, serve to distinguish it from the others wrecked through rottenness and decay. The *blanco*, or trader or judge, who was to get me Indians, spent several days in fruitless search before he obtained for me three villainous-looking, under-sized creatures, who were to accompany me four hours down the river to a village where others could be obtained. I purchased from the judge a heavy, narrow dugout, 30 feet long, and without regret bade adieu to the tumble-down shelter, whose sole dignity consisted in its name, Government House, the only possible place of lodging. I paid my Indians, in advance, two yards apiece of *lienzo* cloth, as is always customary in the country, though it is well not to pay too long in advance in Archidona; I paid them the day before for the

portaging to be done to Napo; they immediately invested their wealth in *chicha*, and at the appointed time of starting some were nowhere to be found, and the others in so advanced a state of intoxication as to be entirely useless.

Very soon after leaving Napo the first rapids are encountered, of a series which succeed each other in rapid succession for the next 100 miles. The banks of the river here are high and precipitous, and present the appearance of having been cut out by the stream; the bed is filled with rock of every size. Napo is a village of erratic existence, most of whose bamboo structures, including church and ramshackle Government House, are in ruins. Here the navigable part of the Napo for canoes begins. The river is narrow and swift of current, with many short, smooth reaches graded out of the weaker structure of land formation which seems to exist with more or less regularity between the harder, stronger rock substance over which the river rushes, forming savage rapids and furious cataracts down the steep slopes in its process of wearing back. From Napo to the Coca river, the stream is of a torrential character, bordered by high banks from which much coarse waste is received, giving rise to the formation of alluvial fans, which seem to impart to the river a tortuous course, or serve at other times to form the rapids of the more moderate slopes, choked with great tree-trunks and huge boulders, which add an embarrassing element to a most precarious navigation.

With competent Indians and good fortune, two days are consumed from Napo to Coca. Trouble began almost immediately with the first lot of Indians. Instead of getting others as previously agreed, an attempt to leave peremptorily was tried. Failing this, and compelled by the persuasion of firearms, at the end of three hours a new lot was obtained, escorted to the beach by the entire village. Not for long, however, for the same night they deserted to a man, or rather boy, for they seemed youths, one a mere child, but all very skilful in handling a canoe. They slipped away in the darkness, and the following day found me marooned in the forsaken village of Aguano. From here the descent was continued blindly and clumsily.

The river between the rapids seemed to consist of but two things, stagnant cul-de-sacs, or side channels always running into a bigger one at right angles, forming maelstrom-like pools, into which the canoe was hurled and thrown against and over the great snags of trees with which the river is filled. The numerous shifting channels are due to the formation of bars and islands of temporary existence owing to the narrow, steep flood plain. Each day of travel here was one of mishap, upset, physical injury, and worry. By the middle of the fourth day a spot known as Berna, two hours above the mouth of the Coca, was reached. It was named by a Swiss, who built himself a zinc roofed house of tropical requirements and modest dimensions; his

successor, a handsome young Italian, received me in a most kind and hospitable manner.

A short distance above Berna is the fall-line of the last rapids, the demarcation between the steeper slopes of older land of rock-formation to the weaker strata of the plain, for from this point the country is of the nature of a broad coastal plain of swampy formation, and heavily forested with a tropical growth. The fall-line is of interest from a historical point of view, as it must have been below this that Pizarro effected the construction of the brigantine. Santa Rosa is claimed by some as the spot, a village 80 miles below Napo village, and of very uncertain existence, for at times it flourishes, at other ceases to be. Above and below is impassable water for anything but a canoe; hence the most probable spot is the junction of the Napo and Coca rivers, or somewhere below.

From Coca to the Amazons the Napo flows through the flat, forested, swampy country in a series of great smooth curves or meanders, the outer plastic banks being continually cut away, involving destruction of trees, with the wrecks of which the river is at all times plentifully supplied, while the inner banks are filled to flood-level with sand or fine silted gravel, offering oftentimes capital beaches for camping and generous supplies of driftwood. The innumerable lakes bordering each side of the river open into the stream by sluggish little channels known as "cochas," and the whole country is a *rete mirabile* of water-courses.

At Berna a rest was made to allow my feet to recover from inflammation from *merigui* flies and sloughing abscesses, left as reminders of the mountain journey, and the negro to recuperate from a rupture as best he could. On the 5th of September, in company with Roggerani, a dozen canoes, and some forty Indians, all on a long expedition of a year to the Tiputini for rubber, progress down the river was resumed. On the eve of the departure from Berna, a grand farewell feast or debauch was indulged in, consisting in an enormous consumption of *chicha*, the beating of drums, straggling processions, during the manœuvres of which flaming torches of cane were held aloft, lighting up and intensifying the weird scene. As morning approached the shrieking choruses gave way to single voices occasionally giving vent to wild, unearthly howls, which gradually died away. At the final leave-taking each squaw was presented by Roggerani with a nickel-plated spoon or a bauble to please her vanity, and gathering in groups upon the shore, with wails and lamentations, accentuated by swinging of arms, they bade adieu to their husbands and sons, who in return blew horns and fired off guns as the Napo current swept the canoe flotilla onward.

For five days we drifted on, sometimes the fleet together, at other times separated and lost to view from each other as the Indians went

off in search of prey. Henrico, an intelligent Indian, was the chief lieutenant of Roggerani's forces. On him devolved the responsibility of keeping the Indians sober and preventing their escape. As this may not be entirely clear, it is worth while here to say a word. A white man, usually Spaniard, Portuguese, or Italian, who establishes himself on any of the confluent branches of the Amazon for obtaining rubber, is known as a *cauchero*. His method of procedure is as follows. From any one of the established trading houses in Iquitos he takes out a credit, say £2000 worth of goods and supplies; he next establishes himself by one of the rivers in an Indian village or settlement, when he disposes of his wares to the Indians at a great profit. As payment, they give themselves, and pay off their debts by being the *cauchero's* slaves for the time being. If he wants rubber, many months are expended on long expeditions in quest of it. The best qualities are found on the hilly lands, which on the east side are the outlying foothills of the Andean system, where rise the headwaters of the smaller streams of the main arteries of the Amazon. Up these they go for weeks; then follow months of weary toiling through the forests on foot. If the expedition is a success the *cauchero* takes his rubber to Iquitos, either by means of the launches which now navigate many of the larger rivers, or transports it by canoe. By contract he is bound to deliver it, or at least an amount which equals the sum and interest of what he has borrowed from the trading house, they in turn disposing of it at profit to the large German houses in Mañaos and Para. In this simple scheme every one comes out well except the Indian. Sometimes the *cauchero* fails, either because his Indians run away after a little, or take fright at the attack of a savage band with their blow-gun (pucuna) made of a long straight piece of wood called chonta, a species of palm. This gun, usually about 8 feet long, and the curara arrow get the better of the miserable flimsy toy-like musket which is supplied to the members of the expedition, as is often the case. The arrow used is a slender stick almost a foot in length. It has a very sharp point dipped in poison, such as curara, while the end next the mouth is wrapped with the light, delicate wild cotton which grows in a pod upon the large silk-cotton so called. In shooting, both hands grasp the mouthpiece, and the guns are used with surprising dexterity, and they exhibit astonishing penetration at short distances. A joint of the bamboo serves as a quiver.

If the expedition is a failure, the *cauchero*, perhaps, is ruined financially. His creditors assume his debts, and since they are put to a little trouble, they immediately declare that instead of the Indians being responsible to them for £2000, they are now responsible for £3000, and must work off every penny of it in rubber operations, and a responsible white man goes to see that they do it. Sometimes in the battles of the rubber forests the savages come out second best. These Indians

represent an exceedingly low order of humanity. Speech is limited to a few signs; it is said they have a knowledge of counting up to five, corresponding with the five digits of the hand. They have a knowledge of fire, but eat their food raw. In captivity the mother expends no care on her offspring. Children are weaned on raw food, it is stated, and are bound to their captors or guardians until manhood is reached. Interesting specimens of this type are to be seen, their left cheek branded, which means slavery until maturity, in the majority of cases for life.

At noon a stop was usually made, the Indians chosen as hunters for that day bringing in wildfowl and monkeys, which, together with rice, yuca, and tea, furnished a splendid feast. Though the Napo has several varieties of monkey, the commonest is a large, heavy-boned one, with thick, coarse reddish hair, or more closely resembling the colour of iron-rust, except on the face, where it is black. Those measured were considerably over 2 feet from glabella to root of tail. To one hungry enough they are delicious eating, and the preparation is simple. The hair is singed off over a fire, the animal is then skinned, followed by decapitation and cut up, great pieces of steaks and limbs put into a good-sized pot and boiled. At night, about sundown, camp was made on some beach, fires lighted—extending for some distance along the shore—round which clustered groups of Indians, coarsely jesting among themselves while they tore off great snacks of monkey-meat, devouring voraciously, or beating each other with the bones; and as the tropical moon rose, the nightly concert from the opposite bank, furnished by the combined vocal efforts of pumas, wild hogs, monkeys, and macaws, would further accentuate the scene, weird enough already in the lurid light.

For several days below the Coca, a cone-shaped peak to the north-west looms up strangely like Cotopaxi; Orton states it is, but dwellers by the river deny this, and call it Sumaco. Late on the night of September 9, the junction of the Tiputini river with the Napo was reached. The Ecuadorian government has its last "politico tenienti" established here. From this point Roggerani's kindness and assistance was sadly missed. Aguarico river flows in a southerly course from the southern slope of the watershed which divides it from the head-waters of the Magdalena, and is of interest to-day as forming the natural boundary-line between Ecuador and Peru. None of the few maps in existence show this, but give Ecuador a much wider range, extending in many cases to the Amazons. This boundary question has been a bone of contention for years, Ecuador, after several unsuccessful attempts to establish a post below the Tiputini, has seemingly abandoned the idea, and each appears to tacitly agree upon the Aguarico.

From here down Peruvian characteristics manifest themselves.

Pottery, of which not a single piece is seen on the Napo above, now becomes most common in every Indian habitation, in the form of bowls and vessels. No wheel is used in the making, the designs are simple, and the colouring from delicate to deep reds. Each tribe adorns this pottery with a series of geometrical designs which show their respective family or tribe, much in the same way as the Alaskan adorns the totem. From the Aguarico to the Curaray, a big river which comes in from the west, it is a long, hard stretch, rendered doubly so by the absence of Indian assistance. The country here is particularly wild and desolate, and abounding in animal-life. The tall cane bordering the banks and forming a fringe to the dense forests furnishes a retreating ground for the pumas, jaguars, and herds of wild hogs, all of which seem to have an especial fondness for the river. Frequently in the afternoon pumas were met, swimming noiselessly up stream, and as many times as not when fired at the hogs dived, staying under water an incredibly long time. Enormous turtles were very common, and the beach for miles scratched with their imprints. Below the Curaray turtles and their eggs are one of the staple articles of food, as is monkey on the upper Napo.

For the last four days before the Curaray is reached, the Napo is filled with islands of all sizes, so grouped as to present narrow vistas or lanes of water, which open out after some miles into large lake-like bodies, or long open winding stretches, bordered with interminable reaches of beach and impenetrable jungles of cane, above which giant palms and silk-cotton trees raise themselves. Not a sign of human life is visible, and it is along this part that the Tambosoyacu, flowing from the north-east, gives itself over to the Napo. Just below the confluence of the Napo and Curaray is situated a large Indian settlement divided into two villages, from the first of which the timid inhabitants, after momentarily viewing from the bank the approach of the canoe, fled to the forest, leaving the village absolutely deserted; but a different reception was accorded at the lower one. The form of celebration common alike to either birth, death, or Sunday was in progress; as both first-named events had ensued within the preceding twenty-four hours, redoubled energy was being spent in the debauch, the yelling and wild shouts increasing each time the muttering thunder gave warning of the fast-approaching tropical storm. Spread over the floor of a huge bamboo house were the prostrate forms of men, women, and children; others lay helpless in the grass beneath; or drunken men, on either side of their still more drunken wives, some even with babies at their breasts, helped to support each other in reeling, staggering groups, cheered by the hoots and cries of the less inebriated. A Peruvian, with a fellow-white as lieutenant, resides as a government factor here, and was kind and hospitable in the most approved South American fashion. He had lost count of days and dates, but my diary

put him right after a discussion as to whether the day was Sunday or Tuesday.

Though the majority of white men here are of easy virtue, the Indian pursues a policy of monogamy, and wives are guarded with a truly surprising spirit of jealousy. The husband must always be spoken to first by a stranger; should the husband find the wife had conversed or held communication with one during his absence, he beats her. It is said this has arisen from Jesuit mission influence, teaching that the white man in general was the devil. It was told me that the Jesuits typified the evil white man as the blue-eyed Englishman, and the simple Indian, with the mind of a child, taking the idea literally, regards with disfavour, suspicion, and withal tremendous curiosity, any white individual who happens to have blue eyes. Judging from a curiously personal and unpleasantly close scrutiny to which I was subjected, first by the elders, then young men, women and children following last, all anxious to see, the blue eye of the Anglo-Saxon still has ascribed to it by the Napo communities the stigma of unjust suspicion and superstitious evil.

The Jesuits, as said before, at present are banished from the Napo, though it would seem as if they were more maligned than they deserved. A hard and trying field in which to work, with a curiously superstitious people, they laboured with a perseverance and an untiring energy which is most praiseworthy in view of the seeming hopelessness of their task. To-day no missionary movement is helping to raise the Napo Indian to a higher state of existence, yet it cannot be denied that other circumstances are curiously effecting a civilization. The Indian question is always an interesting one, and here, as elsewhere, the rule of destiny seems inexorable, the destruction of the Indian, but destruction not in the sense of annihilation, but of disappearance by being merged in the white race. That the process of evolution is slowly but surely being worked out no one can deny who has travelled through the domains of the Hudson Bay Company and seen the offspring of Scotch and Indian progenitors, where it is especially marked, or South America and observed the issue of fusing Spanish or Portuguese with Indian blood.

A strangely incongruous sight is to see an almost nude Indian woman using a sewing-machine, making calico dresses for her children, yet it is not an uncommon event. Even among those Indians who eat squatting on the floor, with fingers for forks, knives, and spoons, the sole article of household furniture may be a Pan-American or a New Haven sewing-machine, in which the female members take the greatest pride. The old Napo costume made out of woven grass or bark is now fast going out of fashion, more up-to-date dresses of cotton and linen being substituted, and a spirit of industry established. With their superstition is a blending of crude spiritualism, such as exists among primitive

races. The devil represents the entire quality of bad that exists, and this lurks in material forms, such as animals with horns, in consequence of which they utterly refuse to touch either cow or deer. They are firm believers in evil spirits, and they gather a special form of grass which they place in their houses at the time of any notable event. Girls marry very young, eleven or twelve being nothing unusual.

The Indians of the lower Napo paint themselves with a black pigment, and stain their finger-nails and teeth. Turtle-hunting is the occupation of many when not engaged in the quest for rubber. Among these small-pox seems to exist unceasingly. Each village had its patients, treatment consisting in isolation, aguandiente, and Perry-Davis painkiller, the last of which is used as extensively here as among the North American Indians.

The lower Napo abounds with the manitou, or sea-cow, great reddish-brown creatures, which follow the canoes for miles. The river is singularly free from alligators; only two rather small ones were seen during the entire time, though in the Ytaya and other small rivers emptying themselves into the Amazon in this same region, I saw large specimens and many of them.

At Mazan, an Indian settlement, two days distant from the south of the Napo descending, it was said that, by a portage of two hours through the forest, one could reach the Amazon, where plenty of Indians and canoes were to be had, by which the journey to Iquitos could be expedited in four days less time. The portage was easily carried out by nine Indians. This accomplished, I found myself marooned with an Indian woman, two small children, a boy just entering the convalescent stage of small-pox, my negro, and no provisions. From this unfortunate predicament, after several days, I was released, and continued the journey to Iquitos. The Mazan river, mapped as yet only by Orton, enters the Napo at Mazan from the west, and if Prescott is right topographically, this must have been the place where Pizarro and Orellana parted, one to retrace his steps by laborious marchings and inconceivable hardships to Quito, the other to drift onward down the unknown mighty Amazon to the Atlantic. Prescott states that Pizarro advanced to within two days of the great river. In reality, however, if this be so, he was within two hours, and had he pushed his way directly through the forest by the track now used occasionally by the Indians, to this rude soldier and bold adventurer there would have belonged the laurels of the discovery. To this day in Papallacta remain some curious skeleton-like forms of saddles, the parts Pizarro and his men did not eat on their return march. It is, however, difficult to distinguish between historical fact and fiction. The doughty Spaniards could never have advanced beyond Papallacta in the saddle, and to this point there would have been no difficulty as to provisions.

There has been hitherto some confusion in regard to the names Marañon and Amazon, whether they were one and the same river, or if not where one ended and the other began. To the Brazilian and Peruvian voyageurs, the Amazon begins 100 miles above Iquitos, or where the Ucayali, flowing north-east, becomes confluent with the Marañon, which flows from the Adean slopes.

The Amazon is navigable for its entire length to ocean-going steamers, and river steamers experience no difficulty in going 1000 miles beyond, up the Ucayali, the whole a giant river system with unsurpassing possibilities, whose wonders are still to be known, of a continent as fascinating as it is strange and marvellous.

THE HYDROGRAPHY OF THE FAEROE-SHETLAND CHANNEL.

By H. N. DICKSON, M.A., B.Sc.

DURING the summer months of 1900, 1901, and 1902, the cutter-yacht *Walwin*, belonging to Dr. R. Norris Wolfenden, has been engaged in scientific research, under the owner's direction, in the channel between the Shetland and Faeroe islands. The physical investigations consisted in (1) observations of temperature, for which Negretti and Zambra's reversing thermometers, Knudsen's modified form of the same, and the ordinary Miller-Casella instrument, were employed, sometimes separately, usually together for purposes of control; and (2) the collection of samples of water by means of Mill's slip water-bottle. Dr. Wolfenden has been good enough to entrust the working out of the observations to me, and I may be permitted at the outset to express the opinion that the way in which they have been made, in a region where work of the kind is always difficult and arduous, and under conditions in many ways unfavourable, reflects the greatest credit on Captain Buchan Henry and his crew. The labours of the *Walwin* have provided a unique series of pictures of the conditions occurring in the channel, representing successive stages in the march of exceedingly complex phenomena with sufficient accuracy, and none of the modern expensive apparatus has been employed in the work, which was carried on from a small cutter of only thirty-six tons.*

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* Some of the 1902 observations were made on the owner's second boat, the *Silver Belle*, a yawl of 130 tons. Dr. Wolfenden states that for all practical purposes the work is as easy to accomplish from the smaller boat. The larger the tonnage the greater the amount of wind required to sail the ship, and a good "sailing breeze" is often too strong for satisfactory working of the instruments.

Table I. gives the characteristic numbers and the positions of the stations at which observations were made.

Table II. gives the temperatures observed. Where the observations were made with more than one instrument, the mean result is given; the differences rarely amounted to more than a few tenths of a degree Fahrenheit. The original readings were made according to the Fahren-

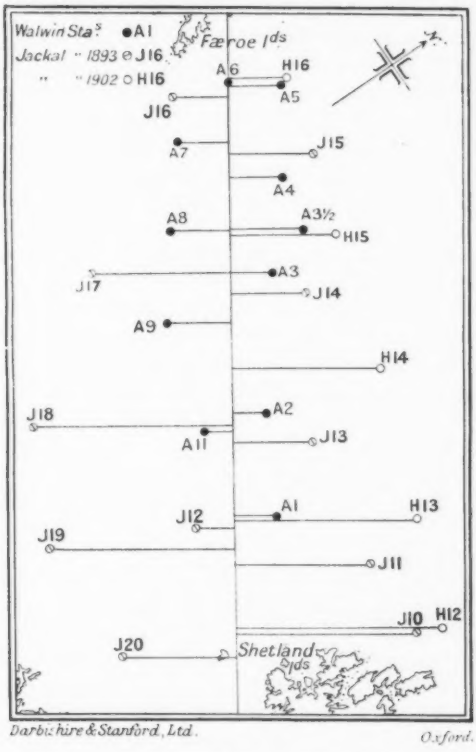

FIG. 1.—MAP SHOWING POSITIONS OF STATIONS AND LINE OF SECTION.

heit scale, and their consistency tested in the usual way by plotting curves. It has been thought best to convert them to the centigrade scale, in which all the observations in the region already published are given, and which is being employed in the International investigations.

Table III. gives the salinities of the samples collected. The chlorine titrations were carried out for me by Mr. J. J. Manley, Magdalen College Laboratory, Oxford, and my best thanks are due to him for his

assistance. The salinities were originally obtained from the chlorines by the use of the table which I published in the Report of the Fishery Board for Scotland (No. 12, 1893, p. 381). They have since been compared with Knudsen's authoritative tables, issued recently; the differences were insignificant. I am indebted to my friend, Mr. O. J. R. Howarth, for assistance in reducing, tabulating, and plotting the results.

In arranging the material for discussion and comparison with other observations, the first point to be noted was that the most important series (and the only ones dealt with here) consist of nearly parallel double lines of soundings, one line starting from near the north end of the Shetlands, and another from near the south end, and both extending to the Faeroes. An examination of all the *Walwin's* observations, of the observations made by the *Jackal* in the cruise of 1893, and again by the *Jackal* in 1902 (see Helland-Hansen in *Nature*, vol. 66, p. 654), indicated that these lines were so close together that they could for all practical purposes be regarded as one and the same. Two points, in positions (approximately) 59° 56′ N. lat., 1° 24′ W. long., and 61° 45′ N. lat., 6° 48′ W. long., were accordingly selected, and joined on the chart by a straight line to which perpendiculars were drawn from the stations (Fig. 1). All the observations were then plotted upon vertical sections along that line. The method is no doubt open to criticism, but the errors introduced cannot exceed the errors incidental to the observations, and it makes the most of the available material.

In the result, we have from the *Walwin's* observations sections for the following dates:—

July, 1900.
May–June, 1901.
June–July, 1901.
May, 1902.
June, 1902.
July, 1902 (temperature only).

To these may be added, completing the existing record:—

Jackal, August, 1893,
„ (preliminary report only), August, 1902,

making eight more or less complete pictures in all (Figs. 2 to 9).*

In the Faeroe-Shetland channel we have to deal with the opposing movements of water from the south and from the north. The northward-moving currents are of two kinds, (*a*) drift currents,

* In these sections the Shetland end of the line is on the right, the Faeroe end on the left.

produced at the surface by the winds in the locality; and (*b*) a stream current, which I have (*Phil. Trans. A.*, vol. 196, p. 113) proposed to call the Norwegian branch of the European stream. This branch forms part of a stream current relieving the water banked up against the continental mass by the westerly winds; it varies in strength from year to year and from season to season, and its salinity also varies slightly, a high salinity probably indicating a large proportion of gulf-stream water, and a low salinity a large proportion of water from the Labrador current and the northern area of the Atlantic. Direct observations in the depth are still wanting, but the range of salinity may be estimated at from 35·4 per mille to 35·7 per mille. The southward-moving currents are also of two kinds, (*c*) water from the central and western parts of the Norwegian sea, most of which has probably originated in the area east and north-east of Newfoundland and been carried across as a drift, mixing with the "Irminger" and "Greenland" branches of the European stream. If the European stream is below its normal strength, it seems likely that this body of water will attain unusual volume, and part of it will try to make its way southward. The comparatively cold salt water observed by the *Jackal* in 1893 (station VIII.), and again by Helland-Hansen in the *Jackal* in 1902 (*Nature, loc. cit.*), in the north-western part of the North sea, is probably to be identified with it, as Helland-Hansen suggests, and it seems likely that the importance of this factor has been under-estimated by the earlier investigators, especially, perhaps, in my report on the work of the *Jackal* in 1893. The second body of southward-moving water (*d*) is that derived from the melting of ice in the Arctic regions. This water is probably spread over the surface in summer and autumn, and makes its way southward to the east of Iceland and the Faeroe islands. So far as the region under discussion is concerned, it may probably be assumed that the water from the centre of the Norwegian sea (*c*) has a salinity of 35 per mille to 35·3 per mille, and that a salinity of less than 35 per mille indicates a large admixture of water of Arctic origin (*d*).

The difficulty of interpreting the sections across the Faeroe-Shetland channel in the light of the above is immensely increased by the fact that the line of section lies just in the region where the waters from the sources mentioned meet and mix, and that we have no simultaneous observations in the regions of origin. The difficulty is specially apparent in studying the distribution of temperature, for, unlike salinity, temperature may change without movement or mixture of the waters. The most important point is evidently to note that when the circulation is active, isothermals and isohalines are crowded together, showing strong gradients of temperature and saltness, while weak gradients are an indication of weak circulation, the waters moving slowly and being very completely mixed.

The general conditions controlling the movement and mixture of waters are: (1) the Norwegian stream (*b*) is cut off below by the Wyville-Thomson ridge at a depth of about 300 fathoms—north of the ridge its waters are mixed with ice-cold water of slightly lower salinity drawn up by the "undertow" to an amount depending partly on the velocity of the stream, and increasing with it (see 'Twelfth Report of the Fishery Board for Scotland,' p. 351); (2) the drift current (*a*) and the European stream are independent of one another, but where the former exists, *i.e.* as a northward-moving current, the waters of (*a*) and (*b*) are likely to be indistinguishable by means of either temperature or salinity observations; (3) the southward-moving waters (*c*) and (*d*) may be independent, and they may or may not be fully mixed before entering the Faeroe-Shetland channel; (4) when the northward-moving currents are strong, they will tend to be surface currents, because of the relatively high temperature of the waters. When they are weak, their waters will be cooled by contact and mixture with the cold underlying waters. The southward-moving waters will tend to be under-currents because of their low temperature, and will only rise to the surface when they are exceptionally strong relatively to the northward-moving currents, or when they contain an unusually large proportion of, on the one hand, warm Norwegian sea-water, or, on the other, fresh Arctic water.

Taking now the sections in order, the first is that for August, 1893, based on the *Jackal* observations. In the report on these observations I expressed the opinion (p. 352) that the conditions were there "favourable to an increase of the Atlantic current," but at the same time it was noted (p. 337) that during the observations the navigating lieutenant of the ship found "a southerly drift amounting to approximately 10 miles in twenty-four hours." With the information available at the time as to the sources from which the waters were derived, it was impossible to identify clearly all the factors involved, or to give a complete explanation of the movements going on. I had to content myself with an attempt to discuss the mechanism of the process of mixture of the northward and southward moving waters, on the assumption that the former (*a* and *b*) were one, and the latter (*c* and *d*) one. The difficulties which arose led me to undertake an investigation of the movements of surface waters in the North Atlantic, and as a result, to separate the stream current (*b*) from the surface drift (*a*); the resolution of the southward-moving waters into (*c*) and (*d*) is chiefly the result of the observations of the *Ingolf* expedition (1896) and of Prof. Pettersson's discussions. In the light of these more recent conclusions it appears from the section (Fig. 2) that in August, 1893, the Norwegian stream was running strongly northward, its main centre lying on the eastern side of the channel at a depth of about 80 fathoms, while its waters extended nearly to the Faeroe islands. The cold bottom water, which shows no

marked tendency to rise towards the surface, was entirely cut off from a thin layer of relatively fresh surface water (salinity below 35·3), which covered the whole surface of the channel to a depth of a few fathoms, and near the Shetlands extended to the bottom. This layer was probably, as Helland-Hansen has suggested, water from the Norwegian sea (*c*), rather than a mixture of it with water which had come from the south through the Faeroe-Shetland channel, as I supposed at the time. Its southward movement would account for its appearance at station VIII. in the north-west of the North sea,

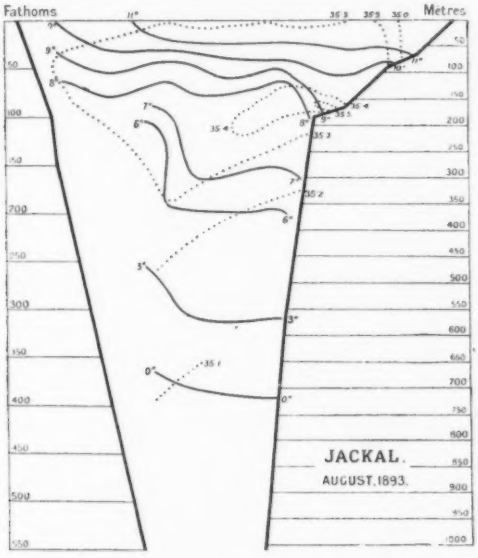

FIG. 2.—FAEROE-SHETLAND CHANNEL. TEMPERATURE AND SALINITY, AUGUST, 1893. H.M.S. *JACKAL*.

referred to above, and for the southerly drift of the *Jackal* during the observations.

The section for July, 1900 (Fig. 3), shows a state of affairs so remarkable that if it were possible to doubt the accuracy of the observations, one would be almost inclined to take refuge in doing so, but the complete consistency of four sets of soundings makes the supposition unreasonable. Salinity is at all depths remarkably high, scarcely falling anywhere below 35·4. At a depth of 400 fathoms, *i.e.* 100 fathoms below the Wyville-Thomson ridge, is a maximum of salinity of 35·6, in water *having a temperature of melting ice*. Above this is a mass of water of salinity about 35·4, the minimum occurring with low temperature

near the middle of the channel in about 250 fathoms. Above this, again, the saltest (35·6) and warmest water lies on the east side of the channel, although close to the Shetlands salinity falls again near the surface. This extraordinary distribution seems to indicate that at an earlier date than that of the section, probably in the previous winter, there had been a strong movement of very salt water from the Norwegian stream and surface drift (*a* and *b*), which from some external cause afterwards failed. Below 300 fathoms the water, protected by the Wyville-Thomson ridge, remained stationary, and was gradually cooled down to 0° C. by contact and slight mixture with the

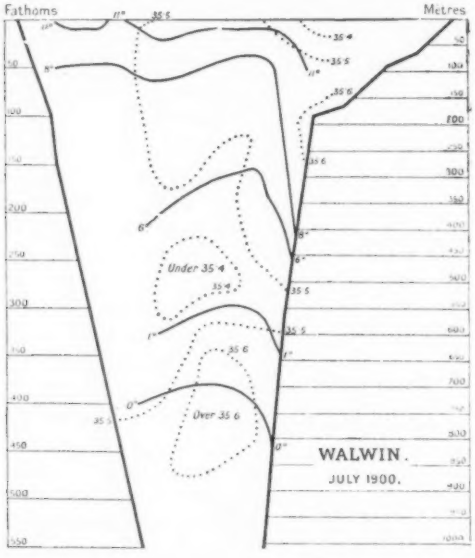

FIG. 3.—FAEROE-SHETLAND CHANNEL. TEMPERATURE AND SALINITY, JULY, 1900. YACHT *WALWIN*.

water lying under it. Above 300 fathoms a southward movement probably set in, lowering both temperature and salinity, and this was followed, probably just before the date of the section, by a re-establishment of the Norwegian stream (*b*) in full force, the water being somewhat salter, but the stream in almost the same position as in 1893 (Fig. 2).

The season 1901 is represented by two sections (Figs. 4 and 5); the observations forming the first were made between May 14 and June 4; those forming the second between July 4 and July 16. Thus the middle dates are May 24 and July 10, and a comparison is of particular interest,

because these are the first sets of observations which have been made in this area at dates close enough to admit of direct comparison, or to give any idea of the rate at which changes occur. In both sections nearly the whole channel is filled with water of 35·5 salinity or over, and in the depth temperature is low. The freshest water (35·3) appears on the east side of the channel at a depth of 380 fathoms, apparently indicating an intrusion of deep water from the Norwegian sea into a mass of Atlantic water, which had been cooled down in the same way as in the previous years. It is to be observed that this centre of low salinity is also one of low temperature, the readings at 300 and 400 fathoms rising

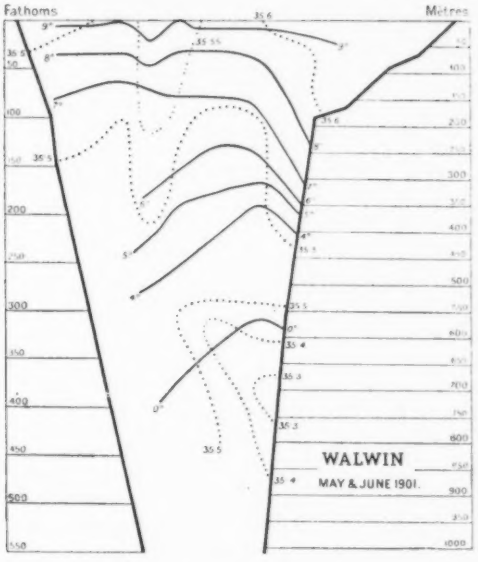

FIG. 4.—FAEROE-SHETLAND CHANNEL. TEMPERATURE AND SALINITY, MAY AND JUNE, 1901. YACHT *WALWIN*.

from east to west. All the western side of the channel is occupied by water of 35·5 salinity. In the strata nearer the surface we find the first indication of the features so strongly marked in 1902, in which the saltest and warmest waters appear as two branches, one a little to the west of mid-channel, and another on the east side, close to the land. In the interval between May 24 and July 10 the distribution in the depth seems to have become more uniform. In the depth the centre of low temperature and salinity on the east side has disappeared, and apparently the whole breadth of the channel is occupied by water of about 35·4 salinity. In the upper layers the two branches of warm

salt water are further apart at the surface, the western member is more strongly marked, while at intermediate depths (100 to 300 fathoms) salinity has increased slightly on the east side, and diminished on the west. The differences point in effect to a strengthening of both the northward and southward moving streams above 300 fathoms, the latter keeping to the west, while the former keeps to the east, but sends a narrow branch, 50 to 60 fathoms deep, along the western side. It is noteworthy that there is no indication of a southward movement of fresher water towards the Shetlands.

For the year 1902 we have four sections (Figs. 6 to 9), the middle

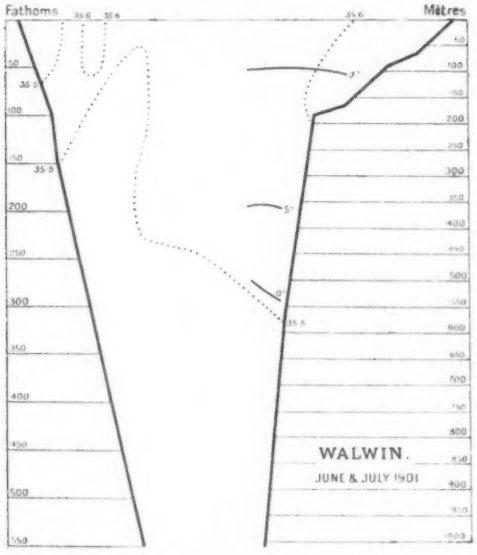

FIG. 5.—FAEROE-SHETLAND CHANNEL. TEMPERATURE AND SALINITY, JUNE AND JULY, 1901. YACHT *WALWIN*.

dates being May 24, June 24, July 21, and August 29. Some are, of course, incomplete, and salinity observations are wanting for the July section, but it seems possible to follow the course of events with considerable certainty.

In the May section the first point to be noticed is the remarkably low temperature and salinity in the depth. Up to within 200 fathoms of the surface the salinity is about 35·2, slightly higher on the east side and lower on the west, while at that depth the temperature is only 2°. Nearer the surface the northward flow of water is apparent, the salinity rising above 35·6 in warm water on the east side, and scarcely

falling below 35·5 on the west. In June it appears that the northward movement had ceased altogether, and that a southward set at all depths has begun, except on the west side of the channel, within about 100 fathoms of the surface, where the conditions remain practically unchanged. The surface salinity is now almost uniformly 35·4, and in the depth the isohalines of 35·2 and 35·1 appear to have moved eastwards. Temperature has fallen at the surface, become more uniform down to the 100-fathom line, and fallen at 400 and 500 fathoms. The June observations reveal for the first time, observations being wanting for May, a steep gradient of temperature on the east side between

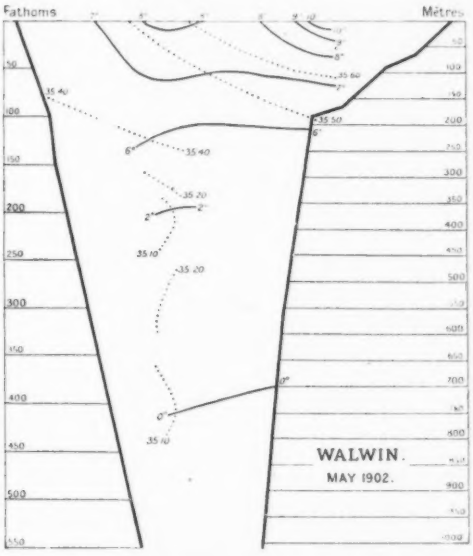

FIG. 6.—FAEROE-SHETLAND CHANNEL. TEMPERATURE AND SALINITY. MAY, 1902. YACHT *WALWIN*.

100 and 200 fathoms. The 2° reading at station A3 at 200 fathoms in May makes it likely that a similar distribution existed during that month.

In the July section the form of the isotherms shows a further advance of cold water in the depth. Temperature has fallen generally, and a wedge of cold water near station A8 rises almost to the surface. On either side of this, warm water, possibly parts of northward-moving streams, extends down to something like 150 fathoms. In the August section, drawn from the observations of H.M.S. *Jackal* published in *Nature*, the cold wedge shows still further advance, and its summit

has shifted more into the centre of the channel. The low salinity at all depths is quite the most remarkable feature of the section, indicating an unusually large proportion of water of Arctic origin in the Norwegian sea. This water appears to be moving southwards in mid-channel, both at the surface and in the depth, a slight weakening being apparent between 50 and 100 fathoms, where the salinity rises above 35·1. On the western side the increase of salinity is so slight as to make it doubtful if any northward movement is taking place; it seems more likely that the 35·4 water observed there in June is merely undergoing mixture with the fresher water, a view supported to some extent by its

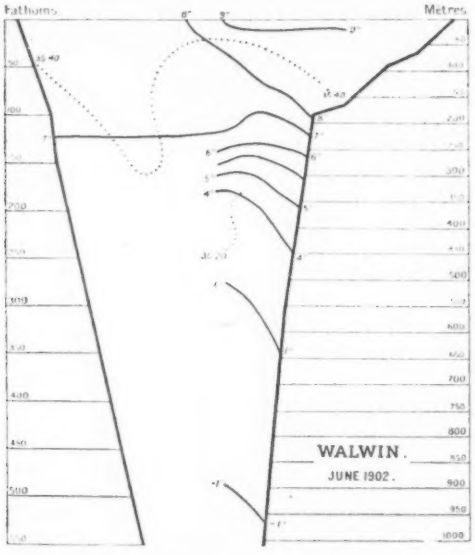

FIG. 7.—FAEROE-SHETLAND CHANNEL. TEMPERATURE AND SALINITY. JUNE, 1902. YACHT *WALWIN*.

steady temperature. A northward movement is, however, apparent on the eastern side, where the temperature is relatively high, and the salinity rises above 35·4.

We may summarize these results as follows :—

1893.—Both northward and southward moving streams strong. The Norwegian stream occupied most of the channel in the intermediate depths; below it water was moving southwards, and on the surface a thin layer also moved southward; this layer became thicker on both sides, and near the Shetlands extended to the bottom.

1900.—The whole channel is occupied by water from the south, northward movement having apparently been strong earlier in the

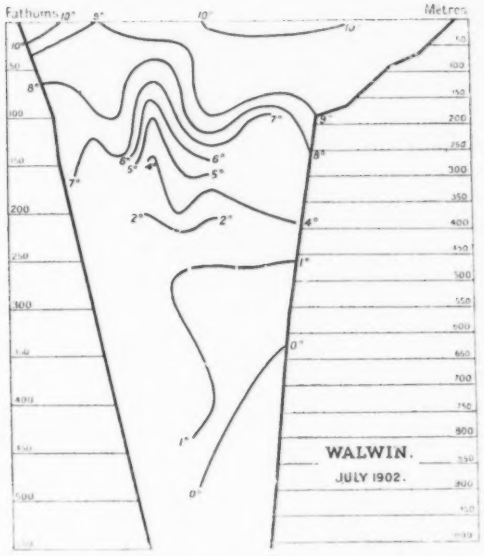

FIG. 8.—FAEROE-SHETLAND CHANNEL. TEMPERATURE AND SALINITY. JULY, 1902.
YACHT *WALWIN*.

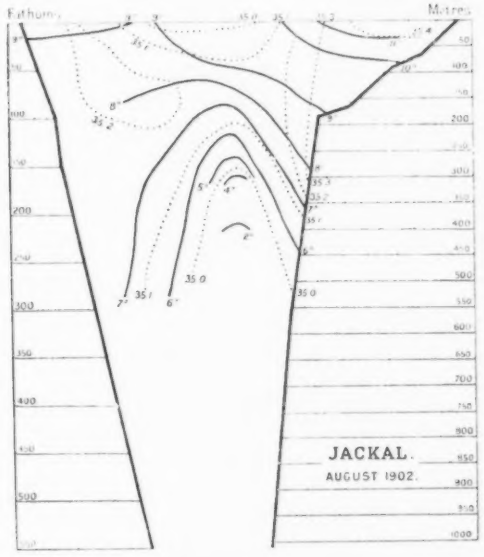

FIG. 9.—FAEROE-SHETLAND CHANNEL. TEMPERATURE AND SALINITY. AUGUST, 1902.
H.M.S. *JACKAL*.

season. At the date of the observations (July) little movement was in progress, but there are indications of intrusion of water from the north at a depth of about 300 fathoms, and at the surface on the east side.

1901.—There are indications of feeble southward movement in the depth, but most of the channel is occupied by water which has come from the south. A weak northerly movement is apparent near the surface, with some tendency to split into two branches, one west of mid-channel, the other near the east side.

1902.—Unusually cold fresh water filled the channel, at all depths below 150 fathoms, throughout the season. In May the surface waters were of southern origin, and were moving northward, but as the season progressed, southward movement increased both at the surface and in the depth, especially in mid-channel, the waters mixing with and driving out those of southern origin on each side. That this movement extended far to the southward is shown by the fact that an ice-floe was met with during July off the Treshinish islands, on the west side of Mull. The summer of 1902 was one of the worst on record in the Faeroe-Shetland channel, and hydrographical work was exceedingly difficult.

A comparison of the 1902 sections with the admirable charts of surface temperature published as insets in the British 'Pilot Chart of the North Atlantic,' shows in the clearest manner the relation between the surface movements in the open ocean and the currents in the channel. In May the surface temperature was normal, or slightly below it, between the west coast of the British Isles and about long. 15° W. Further west, and to the north-west, there was a narrow band of water above the normal temperature, obviously supplying the water which was going northward on the east side of the channel. In June temperature was apparently below the normal over the whole of the surface of the eastern Atlantic, and in the subsequent months the area of low temperature gradually narrowed, until in October it had entirely disappeared.

I hope to obtain data with regard to atmospheric pressure, similar to those embodied in the Pilot Chart for October, for the earlier months, and to discuss their relation to the observations in the Faeroe-Shetland channel in a later paper. The Pilot Charts in their present form will be an invaluable help in interpreting the observations to be made under the international scheme, and, as Dr. Wolfenden informs me that he intends to make simultaneous observations at depths down to 1000 fathoms to the west of Ireland, the mechanism of the currents flowing from the central region should be completely and finally determined.

The conclusions arrived at up to the present may be stated thus:—

1. Northward movement of water originating as a *drift* current is strongest in the Faeroe-Shetland channel during winter.

2. Northward movement of water originating as a *stream* current is strongest in summer, being probably due to the extension of the "Atlantic anticyclone."

3. The northward movement 2 is the more uncertain, and varies most in different years.

4. In the transition stages between 1 and 2, or when 2 is abnormally weak, the water in the Faeroe-Shetland channel may remain practically motionless for extended periods. If the channel is filled with water from the south, this water will gradually cool down and sink, being cooled by, and mixing with, the cold underlying waters.

5. To the north of the Faeroe-Shetland channel the waters of the Norwegian sea consist of a mixture of waters of Arctic origin with those of Atlantic origin, the latter very similar to 1. The mixture is in most cases fairly complete, but during summer water of Arctic origin, set free by the melting of ice, may form a surface layer of considerable thickness.

6. The waters of the Norwegian sea make their way southward, under favourable conditions, into the Faeroe-Shetland channel and the North sea. The entrance to the North sea is probably effected every year, as there is no opposing northerly current on the western side. In the Faeroe-Shetland channel the southward movement is normally prevented by the northerly currents 1 and 2, except at depths below 300 fathoms, where the northward currents are cut off by the Wyville-Thomson ridge, and at the surface, where there may be a southerly drift current. In exceptional cases, as in 1902, the northerly movement may be in abeyance, and water may move southward at all depths. It seems likely that the presence of this water in the North sea has a special bearing on biological and fishery questions.

7. The movements of the surface waters of the sea and the temperature of the air near the British Isles do not stand in any direct relation of cause and effect. Northerly winds bring cold weather, and by drifting and "banking" cold water from higher latitudes, bring cold surface water with them. Southerly winds bring warm weather, and bring warm water from low latitudes in the same way. The temperature of the surface water in the open sea influences the distribution of atmospheric pressure, as Pettersson has shown, and it will therefore affect the direction of the prevailing winds, but motion has nothing to do with this influence.

TABLE I.*

List of "Walwin" Stations.

Station.	Lat. N.	Long. W.	Station.	Lat. N.	Long. W.
	° ′	° ′		° ′	° ′
A1	60 40	2 50	A10	60 17	3 5
A2	60 54	3 40	A11	60 27	3 50
A3	61 16	4 41	B1	60 51	6 22
A3½	61 28	4 50	B2	60 17	6 22
A4	61 32	5 20	B3	59 46	6 20
A5	61 45	6 02	B4	60 00	5 20
A6	61 34	6 20	III.	Off Fitful Head.	
A7	61 14	6 08	IV.	West of Yell sound.	
A8	61 00	5 30	V.	Off Flugga L. H.	
A9	60 45	4 50	VI.	East of Bressay.	

TABLE II.

Temperature Observations.

Date.	Position.	Depth. fath.	Depth. m.	Temp. C.
1899.				
July 1	8 miles off Hoy Hd.	0	0	10·6
,,	,,	30	55	10·0
,,	N. of Westray ...	0	0	10·6
,,	,, ...	40	73	10·6
,,	S.W. of Sumburgh Hd.	0	0	9·7
,,	,,	65	119	8·9
,, 3	N.W. of Yell sound	0	0	11·7
,,	,,	50	91	10·8
,,	N.E. of Lamba Ness	0	0	11·7
,,	,,	55	101	9·4
,, 4	E. of Bressay ...	0	0	12·2
,,	,, ...	55	101	8·1
,,	E. of Fair Isle ...	0	0	10·0
,,	,,	60	110	8·6
,,	E. of Copinshay ...	0	0	10·6
,,	,,	43	79	8·9
Oct. 14	8 miles off Hoy Hd.	0	0	10·6
,,	,,	40	73	11·1
,, 21	Station IV. ...	0	0	9·4
,,	,, ...	59	108	10·6
,, 23	Station V. ...	0	0	9·7
,,	,, ...	55	101	10·3
,, 27	Station VI. ...	0	0	9·4
,,	,, ...	52	95	11·1
Nov. 10	Station III. ...	0	0	7·2
,,	,, ...	55	101	8·1
,, 25	Station IV. ...	0	0	6·9
,,	,, ...	60	110	9·4
,, 27	Station V. ...	0	0	8·3
,,	,, ...	52	95	9·2
Dec. 3	Station VI. ...	0	0	7·2
,,	,, ...	50	91	8·9
,, 5	Station III. ...	0	0	6·7
,,	,, ...	55	101	8·9
1899.				
Dec. 15	Station IV. ...	0	0	6·9
,,	,, ...	40	73	8·6
,, 18	Station V. ...	0	0	7·2
,,	,, ...	56	102	8·6
1900.				
Jan. 1	Station VI. ...	0	0	7·2
,,	,, ...	52	95	7·8
,,	Station III. ...	0	0	7·5
,,	,, ...	59	108	8·1
,, 30	Station IV. ...	0	0	7·5
,,	,, ...	53	97	8·1
Feb. 9	Station V. ...	0	0	7·2
,,	,, ...	54	99	7·5
,, 14	Station VI. ...	0	0	6·1
,,	,, ...	46	84	6·9
,,	Station III. ...	0	0	5·8
,,	,, ...	61	111	6·7
Mar. 1	Station IV. ...	0	0	5·0
,,	,, ...	58	106	5·8
,, 3	Station V. ...	0	0	6·1
,,	,, ...	53	97	6·4
,, 4	Station VI. ...	0	0	6·1
,,	,, ...	59	108	6·1
,, 6	Station III. ...	0	0	6·1
,,	,, ...	70	128	6·4
,, 23	Station IV. ...	0	0	6·1
,,	,, ...	55	101	6·1
,, 24	Station V. ...	0	0	5·8
,,	,, ...	47	86	6·4
,, 27	Station VI. ...	0	0	5·0
,,	,, ...	50	91	5·8
,, 30	Station III. ...	0	0	4·4
,,	,, ...	64	117	5·6
Apr. 21	Station IV. ...	0	0	6·7
,,	,, ...	53	97	6·4

* For numbers and positions of the *Jackal* stations in 1893 and 1902, see 'Twelfth Report of the Fishery Board for Scotland,' p. 364, and *Nature*, vol. 66, p. 654.

Date.	Position.	Depth. fath.	Depth. m.	Temp. C.
1900.				
April 22	Station V.... ...	0	0	6·7
,,	,, ...	54	99	6·7
,, 24	Station VI. ...	0	0	6·4
,,	,, ...	65	119	6·4
,, 27	Station III. ...	0	0	5·8
,,	,, ...	65	119	5·8
May 24	Station V. ...	0	0	8·4
,,	,, ...	54	99	7·2
,, 25	Station IV. ...	0	0	8·6
,,	,, ...	64	117	7·2
,, 26	Station III. ...	0	0	6·9
,,	,, ...	66	121	6·4
June 9	17 miles W.N.W. of Flugga L. H.	0	0	8·4
,,	,,	66	121	8·4
,,	6 miles off Yell sound	0	0	8·1
,,	,,	55	101	7·2
,, 12	Station IV. ...	0	0	10·0
,,	,, ...	72	132	8·6
,, 13	10 miles S.S.W. of IV.	0	0	9·2
,,	,,	60	110	7·8
,,	Station III. ...	0	0	8·6
,,	,,	62	113	7·5
July 11	Station A1... ...	0	0	13·3
,,	,, ...	50	91	11·1
,,	,, ...	100	183	10·6
,,	,, ...	150	274	9·4
,,	Station A2 ...	0	0	11·1
,,	,, ...	50	91	7·2
,,	,, ...	100	183	7·2
,, 12	Station A3 ...	0	0	11·1
,,	,, ...	50	91	8·1
,, 13	Station A4 ...	0	0	10·3
,,	,, ...	50	91	7·9
,,	,, ...	93	170	7·2
,,	Station A5 ...	0	0	11·1
,,	,, ...	50	91	7·9
,,	,, ...	84	154	7·9
,, 21	Station A6 ...	0	0	10·6
,,	,, ...	100	183	8·1
,,	Station A7 ...	0	0	10·6
,,	,, ...	50	91	8·1
,, 22	Station A8 ...	0	0	11·4
,,	,, ...	100	183	7·8
,,	,, ...	350	640	0·6
,, 23	Station A9 ...	0	0	11·7
,,	,, ...	100	183	8·9
Aug. 28	10 miles N.E. ½ N. from Station A1	0	0	12·2
,,	,, ...	50	91	9·4
,,	,, ...	100	183	9·2
,,	,, ...	200	366	8·1
,,	,, ...	280	512	7·8
,,	20 miles N.N.E. of Station A1	0	0	12·2
,,	,,	80	146	9·1
,,	,,	150	274	8·4
,,	,,	250	457	6·1
,,	,,	350	640	−0·6
,, 29	Station A2 ...	0	0	11·4
,,	,, ...	50	91	8·5
,,	,, ...	100	183	7·1
,,	,, ...	200	366	5·3
,,	,, ...	300	549	1·0
,,	,, ...	400	732	0·0

Date.	Position.	Depth. fath.	Depth. m.	Temp. C.
1900.				
Aug. 29	Station A2 ...	500	914	−0·7
Oct. 4	Station III. ...	0	0	9·4
,,	,, ...	70	128	10·0
,, 10	Station IV. ...	0	0	10·0
,,	,, ...	75	104	10·6
,, 16	Station V.... ...	0	0	8·9
,,	,, ...	75	137	10·0
,, 19	Station VI. ...	0	0	10·0
,,	,, ...	57	104	10·0
1901.				
Jan. 12	Station IV. ...	0	0	7·8
,,	,, ...	62	113	7·8
,, 19	Station V.... ...	0	0	7·2
,,	,, ...	55	101	7·8
Feb. 2	Station VI. ...	0	0	6·1
,,	,, ...	60	110	7·2
,,	Station III. ...	0	0	5·6
,,	,, ...	62	113	6·7
May 14	Station A1 ...	0	0	9·7
,,	,, ...	114	209	8·6
,, 15	Station A2 ...	0	0	9·2
,,	,, ...	45	82	7·4
,,	,, ...	100	183	6·1
,,	,, ...	200	366	3·0
,,	,, ...	300	549	0·1
,,	,, ...	400	732	−0·6
,,	,, ...	500	914	−1·0
,, 21	Station A3 ...	0	0	8·9
,,	,, ...	45	82	7·3
,,	,, ...	100	183	6·8
,,	,, ...	200	366	4·7
,,	,, ...	300	549	1·2
,,	,, ...	400	732	−0·2
,,	Station A4 ...	0	0	8·9
,,	,, ...	45	82	7·5
,,	,, ...	115	210	6·7
,,	,, ...	120	220	6·7
,,	Station A5 ...	0	0	8·9
,,	,, ...	90	165	6·7
,, 29	Station A6 ...	0	0	9·2
,,	,, ...	45	82	7·5
,,	,, ...	100	183	6·8
,,	,, ...	145	265	6·7
,,	,, ...	150	274	6·7
,,	Station A7 ...	0	0	9·2
,,	,, ...	45	82	7·8
,,	,, ...	80	146	6·7
,,	,, ...	135	247	6·7
June 3	Station A8 ...	0	0	10·1
,,	,, ...	45	82	8·1
,,	,, ...	100	183	6·7
,,	,, ...	200	366	5·7
,,	,, ...	255	467	4·2
,,	Station A9 ...	0	0	10·8
,,	,, ...	45	82	7·5
,,	,, ...	100	183	6·4
,,	,, ...	200	366	4·7
,,	,, ...	300	549	0·8
,,	,, ...	400	732	−0·3
,, 4	Station A11 ...	0	0	10·6
,,	,, ...	50	91	8·9
,,	,, ...	100	183	8·4
,,	,, ...	200	366	8·4
,, 19	Station A1 ...	0	0	9·7
,,	,,	50	91	9·0
,,	,,	100	183	8·4
,,	,,	110	201	8·4

Date.	Position.	Depth. fath.	Depth. m.	Temp. C.
1901.				
June 20	Station A2 ...	0	0	10·0
,,	,,	45	82	9·1
,,	,,	100	183	8·5
,,	,,	200	366	4·4
,,	,,	300	549	0·1
,,	,,	400	732	−0·3
,,	,,	500	914	−0·7
July 27	Station A1 ...	0	0	12·5
,,	,,	45	82	9·4
,,	,,	80	146	8·9
,,	,,	130	238	8·6
,,	Station A2 ...	0	0	12·2
,,	,, ...	45	82	9·2
,,	,, ...	100	183	7·8
,,	,, ...	500	914	−0·7
1902.				
May 17	Station A1 ...	0	0	10·8
,,	,, ...	100	183	6·1
,, 18	Station A2 ...	0	0	7·8
,,	,, ...	400	732	−0·1
,,	,, ...	500	914	−0·6
,,	,, ...	608	1112	−1·1
,, 20	Station A3 ...	0	0	8·4
,,	,, ...	50	91	7·2
,,	,, ...	100	183	6·1
,,	,, ...	200	366	1·9
,,	,, ...	300	549	0·6
,,	,, ...	400	732	0·2
,, 21	Station A4 ...	0	0	7·2
,,	,, ...	50	91	6·7
,,	,, ...	108	198	6·7
June 1	Station B3 ...	0	0	8·6
,,	,, ...	50	91	8·4
,,	,, ...	100	183	7·2
,, 19	Station A1 ...	0	0	9·2
,,	,, ...	110	201	7·8
,, 21	Station A2 ...	0	0	8·4
,,	,, ...	200	366	3·9
,, 22	Station A3 ...	0	0	7·8
,,	Station A4 ...	0	0	7·9
,,	,, ...	50	91	7·5
,,	,, ...	110	201	7·2
,,	Station A5 ...	0	0	8·1
,,	,, ...	55	101	7·2
,, 26	Station A6 ...	0	0	8·6
,,	,, ...	110	201	7·2
,, 27	Between A7 and A8	0	0	8·9
,,	,,	155	284	6·7
,, 28	Between A2 and A9	0	0	9·4
,,	,,	50	91	7·8
,,	,,	100	183	7·2
,,	,,	200	366	2·8
,,	,,	300	549	0·6
,,	,,	400	732	−0·3
,,	,,	500	914	−1·1
,,	Station A2 ...	0	0	9·4
,,	,, ...	50	91	8·4

Date.	Position.	Depth. fath.	Depth. m.	Temp. C.
1902.				
June 28	Station A2 ...	100	183	6·7
,,	,, ...	200	366	4·4
,,	,, ...	300	549	1·4
,,	,, ...	400	732	−0·6
,,	,, ...	500	914	−0·7
,,	,,	600	1097	−1·1
,, 29	Between A1 and A10	0	0	9·4
,,	,,	120	220	8·9
July 9	6 miles inside A1...	0	0	10·0
,,	,,	80	146	8·4
,, 15	Station A2 ...	0	0	10·0
,,	,, ...	50	91	7·8
,,	,, ...	100	183	6·7
,,	,, ...	200	366	3·9
,,	Station A3 ...	0	0	9·4
,,	,, ...	50	91	7·8
,,	,, ...	100	183	6·7
,,	,, ...	200	366	3·9
,, 16	Station A4 ...	0	0	9·4
,,	,, ...	120	220	7·8
,, 17	Station A5 ...	0	0	8·4
,,	,, ...	75	137	7·8
,, 20	Station A6 ...	0	0	10·6
,,	,, ...	120	220	7·8
,,	Station A7 ...	0	0	8·9
,,	,, ...	120	220	6·9
,, 21	8 miles E. of A8 ...	0	0	9·7
,,	,,	50	91	7·2
,,	,,	100	183	5·0
,,	,,	260	366	1·9
,,	,,	260	476	1·1
,,	Station A9 ...	0	0	10·0
,,	,, ...	50	91	9·4
,,	,, ...	100	183	8·9
,,	,, ...	200	366	2·2
,,	,, ...	400	732	1·1
,,	,, ...	500	914	−0·6
,, 22	11 miles S. of A11	0	0	10·6
,,	,,	80	146	8·9
,,	Station A10 ...	0	0	9·4
,,	,, ...	80	146	8·6
Aug. 1	17 miles off Foula	75	137	8·4
,,	Station A1 ...	0	0	11·4
,,	,, ...	110	201	8·9
,, 3	10 miles S. of A2...	0	0	10·6
,,	,,	100	183	6·7
,,	,,	200	366	3·9
,,	,,	300	549	0·3
,,	,,	400	732	−0·6
,,	,,	500	914	−1·1
,, 5	10 miles S. of A9...	0	0	10·7
,,	,,	200	366	8·4
,,	,,	400	732	0·0
,,	,,	500	914	−0·6
,,	Station B4 ...	0	0	11·7
,,	,, ...	150	274	9·2
,,	,, ...	260	476	8·4

TABLE III.

Salinity Observations.

No. of sample.	Date.	Position.	Depth. fath.	Depth. m.	Cl.	Salinity per mille
	1900.					
1	May 24	V.	0	0	19·59	35·40
2	,, 25	IV.	0	0	19·67	35·54
3	,, 26	III.	0	0	19·66	35·52
4	June 3	III.	0	0	19·63	35·47
5	,, 12	IV.	0	0	19·66	35·52
6	,, 13	III.	0	0	19·77	35·72
7	July 11	A1	0	0	19·58	35·38
8	,,	,,	100	183	19·74	35·66
9	,,	,,	150	274	19·67	35·54
10	,,	A2	400	732	19·70	35·59
11	,,	,,	500	914	19·67	35·54
12	,, 12	A2	0	0	19·65	35·50
13	,,	,,	100	183	19·65	35·50
14	,,	,,	200	366	19·68	35·56
15	,,	,,	300	549	19·61	35·43
16	,,	A3	0	0	19·65	35·50
17	,,	,,	100	183	19·65	35·50
18	,,	,,	200	366	19·63	35·47
19	,,	,,	300	549	19·58	35·38
20	,, 13	A4	0	0	19·61	35·43
21	,,	,,	50	91	19·63	35·47
22	,,	,,	90	165	19·61	35·43
23	,,	A5	0	0	19·61	35·43
24	,,	,,	50	91	19·61	35·43
25	,,	,,	80	146	19·60	35·41
26	,, 20	A7	0	0	19·67	35·54
27	,, 21	A6	0	0	19·61	35·43
28	,,	A7	100	183	19·65	35·50
29	,,	,,	150	274	19·61	35·43
30	,, 22	A8	0	0	19·65	35·50
31	,,	,,	100	183	19·65	35·50
32	,,	,,	150	274	19·65	35·50
33	,,	,,	250	457	19·60	35·41
34	,,	,,	350	640	19·61	35·43
35	,,	,,	450	823	19·67	35·54
36	,, 23	A9	0	0	19·67	35·54
37	,,	,,	100	183	19·65	35·50
38	,,	,,	250	457	19·58	35·38
39	,,	,,	350	640	19·72	35·63
40	,,	,,	440	805	19·75	35·68
41	Oct. 4	III.	35	64	19·65	35·50
42	,,	,,	70	128	19·59	35·40
43	,,	,,	0	0	19·67	35·54
44	,, 10	IV.	30	55	19·67	35·54
45	,,	,,	57	104	19·73	35·64
46	,, 16	V.	70	128	19·76	35·70
47	,,	,,	35	64	19·61	35·43
48	,, 19	VI.	30	55	19·60	35·41
49	,,	,,	57	104	19·39	35·03
50	,, 20	IV.	0	0	19·65	35·50
	1901					
51	Jan. 12	IV.	0	0	19·59	35·40
52	,,	,,	115	210	19·71	35·61
53	,, 19	V.	0	0	19·51	35·25
54	,,	,,	112	205	19·61	35·43
55	Feb. 2	III.	0	0	19·63	35·47
56	,,	,,	130	238	19·59	35·40
57	,,	VI.	0	0	19·60	35·41
58	,,	,,	153	280	19·65	35·50
59	May 14	A1	0	0	19·71	35·61
60	,,	,,	57	104	19·72	35·63
61	,,	,,	114	209	19·67	35·54
62	,,	,,	0	0	19·74	35·66
	1901.					
63	May 15	A2	0	0	19·70	35·59
64	,,	,,	100	183	19·65	35·50
65	,,	,,	200	366	19·65	35·50
66	,,	,,	300	549	19·65	35·50
67	,,	,,	400	732	19·53	35·28
68	,,	,,	500	914	19·61	35·43
69	,,	60° 43′ N. 3° 22′ W.	0	0	19·69	35·58
70	,,	60° 35′ N. 2° 25′ W.	0	0	19·76	35·70
71	,, 21	A3	0	0	19·69	35·58
72	,,	,,	100	183	19·67	35·54
73	,,	,,	200	366	19·65	35·50
74	,,	,,	300	549	19·65	35·50
75	,,	,,	400	732	19·65	35·50
76	,,	A4	0	0	19·66	35·52
77	,,	,,	80	146	19·65	35·50
78	,,	,,	115	210	19·63	35·47
79	,,	A5	0	0	19·65	35·50
80	,,	,,	80	146	19·65	35·50
81	,, 29	A6	0	0	19·63	35·47
82	,,	,,	100	183	19·65	35·50
83	,,	,,	150	274	19·65	35·50
84	,,	A7	0	0	19·65	35·50
85	,,	,,	80	146	19·65	35·50
86	,,	,,	130	238	19·65	35·50
87	,,	61° 37′ N. 6° 18′ W.	0	0	19·70	35·59
88	,, 30	61° 30′ N. 6° 37′ W.	0	0	19·81	35·79
89	June 3	A8	0	0	19·69	35·58
90	,,	,,	100	183	19·69	35·58
91	,,	,,	200	366	19·66	35·52
92	,,	,,	255	467	19·65	35·50
93	,,	A9	0	0	19·67	35·54
94	,,	,,	100	183	19·63	35·47
95	,,	,,	200	366	19·65	35·50
96	,,	,,	300	549	19·61	35·43
97	,,	,,	400	732	19·65	35·50
98	,,	60° 56′ N. 5° 18′ W.	0	0	19·65	35·50
99	,, 4	A11	0	0	19·72	35·63
100	,,	,,	100	183	19·78	35·73
101	,,	,,	200	366	19·68	35·56
102	,,	60° 37′ N. 3° 30′ W.	0	0	19·71	35·61
103	,, 19	A1	0	0	19·68	35·56
104	,,	,,	50	91	19·71	35·61
105	,,	,,	100	183	19·71	35·61
106	July 4	,,	0	0	19·70	35·59
107	,,	,,	80	146	19·71	35·61
108	,,	,,	115	210	19·69	35·58
109	,, 5	A2	0	0	19·67	35·54
110	,,	,,	100	183	19·67	35·54
111	,,	,,	200	366	19·66	35·52
112	,,	,,	300	549	19·65	35·50
113	,,	,,	400	732	19·63	35·47
114	,,	,,	500	914	19·65	35·50
115	,, 6	A3½	0	0	19·65	35·50
116	,,	,,	100	183	19·63	35·47
117	,,	,,	220	403	19·66	35·52
118	,,	A4	0	0	19·67	35·54
119	,,	,,	80	146	19·65	35·50

No. of sample.	Date.	Position.	Depth. fath.	Depth. m.	Cl.	Salinity per mille	No. of sample.	Date.	Position.	Depth. fath.	Depth. m.	Cl.	Salinity per mille
	1901.							1902.					
120	July 6	A4	110	201	19·65	35·50	142	July 21	A4	100	183	19·60	35·41
121	,, 7	A5	0	0	19·65	35·50	143	,, 30	A6	0	0	19·63	35·46
122	,, 14	A6	0	0	19·70	35·59	144	,,	,,	100	183	19·59	35·39
123	,,	,,	45	82	19·65	35·50	145	,, 31	B1	0	0	19·65	35·50
124	,,	,,	100	183	19·68	35·56	146	June 1	B2	0	0	19·72	35·62
125	,,	A7	0	0	19·72	35·63	147	,,	B3	0	0	19·79	35·75
126	,,	,,	50	91	19·71	35·61	148	,, 19	A1	0	0	19·62	35·44
127	,,	,,	120	220	19·63	35·47	149	,,	,,	100	183	19·59	35·39
128	,, 15	A8	0	0	19·66	35·52	150	,, 21	A2	0	0	19·60	35·41
129	,,	,,	100	183	19·65	35·50	151	,, 22	A3	0	0	19·60	35·41
130	,,	,,	200	366	19·70	35·59	152	,,	,,	100	183	19·57	35·35
131	,,	,,	266	487	19·61	35·43	153	,,	,,	200	366	19·59	35·39
132	,, 16	A9	400	732	19·63	35·47	154	,,	A4	0	0	19·61	35·43
	1902.						155	,,	,,	100	183	19·60	35·41
133	May 17	A1	0	0	19·74	35·66	156	,,	A5	0	0	19·63	35·46
134	,,	,,	50	91	19·72	35·62	157	,, 26	A6	0	0	19·60	35·41
135	,,	,,	100	183	19·65	35·50	158	,,	,,	100	183	19·59	35·39
136	,, 20	A3	0	0	19·69	35·57	159	,, 27	Between A7 and A8	0	0	19·60	35·41
137	,,	,,	100	183	19·61	35·43							
138	,,	,,	200	366	19·43	35·10	160	,,	,,	155	284	19·59	35·39
139	,,	,,	300	549	19·50	35·23	161	,, 28	Between A2 and A9	200	366	19·48	35·19
140	,,	,,	400	732	19·48	35·19							
141	,, 21	A4	0	0	19·63	35·46	162	,,	,,	400	732	19·42	35·08

THE VOLCANIC ERUPTION ON TORISHIMA.

Herr Max Kutschera, Austro-Hungarian consul at Yokohama, contributes a short article on the volcanic eruption on the island of Torishima to the *Mitteilungen* of the Vienna Geographical Society. As little information about this remarkable outburst has reached this country, we reproduce Herr Kutschera's paper in full.

The expedition despatched to Torishima by the steamer *Hiogo Maru* on August 22, has just returned. The official report of the two University professors sent as scientific experts has not yet been issued, but we have the accounts of newspaper correspondents who accompanied the party, and sketches of the island as it appeared before and after the eruption have been published in the Japanese paper *Tokyo Nichi-Nichi*.

Figures 1 and 3 represent the original form of Torishima. The highest mountain peak (1) was Komochi-yama, 359 metres in height, in the centre of the island, a long-extinct volcano with three small craters (14). On the flanks of Komochi-yama was Asahi-gama (335 metres), on the north-east (3), and Tsukiji-yama (265 metres) on the south-west (2). The mountains sloped steeply to the coast, which had only one large inlet, Chitosema (4), on the north. Behind this inlet, on a terrace 27 metres above the sea, was the settlement Tamaki-mura (5), consisting of forty houses, and named after the farmer of the island, Mr. Han-imon Tamaki, in whose service the inhabitants hunted birds and collected and shipped feathers, birds' bones, and guano. To facilitate their work, a small tramway worked with a wire rope (6) had been laid halfway up the Komochi-yama. The actual hunting season on Torishima lasted from November to February, and during these months some 500 people resided on the island. The produce of the island last year amounted to—feathers, 9622 yen (1 yen = 2s.); birds' bones, 522.20 yen; guano, 3780 yen; and oil, 6630 yen. The settlers possessed 39 cattle and

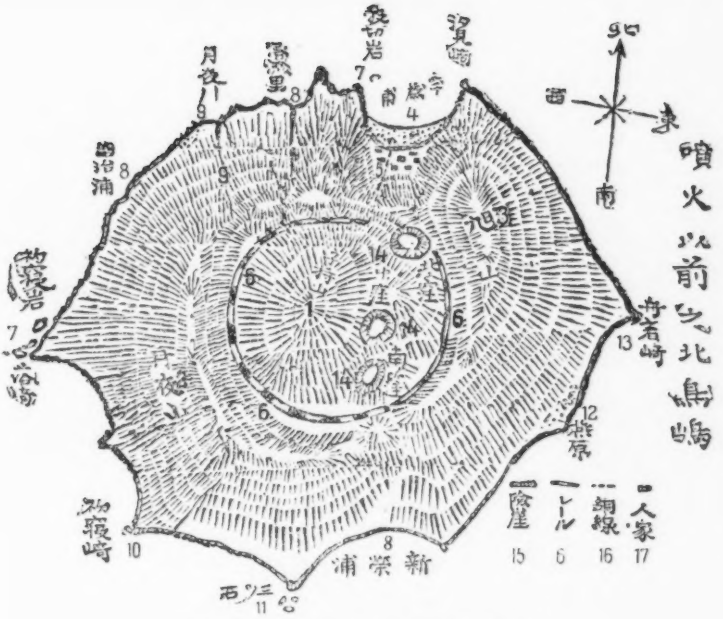

FIG. 1.—TORISHIMA BEFORE THE OUTBREAK.

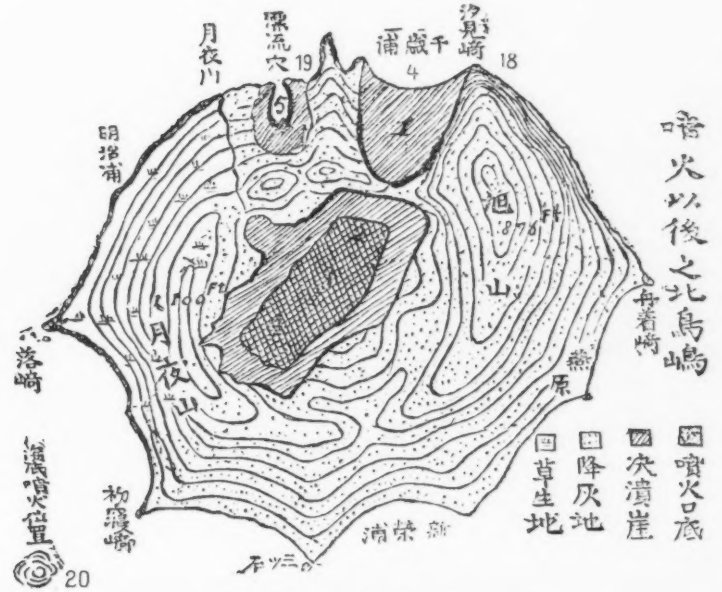

FIG. 2.—TORISHIMA AFTER THE OUTBREAK.

46 pigs, and had cultivated gardens, growing potatoes and other vegetables. Most of the island was covered with grass and bush. Several islets (7 and 11) studded the coast, which was broken by smaller inlets, as (8). A small brook (9), flowing from Komochi-yama, entered the sea in the north-west. The coast between Cape Katsumi (10) and Cape Funatsuki (13) was flat and sandy in places, elsewhere the slope to the sea was steep, as at (15).

FIG. 3.—TORISHIMA, SEEN FROM THE NORTH BEFORE THE OUTBREAK.

After the eruption the island appeared as shown in Figs. 2 and 4. The peak of Komochi-yama has entirely disappeared, and its place is occupied by a crater 400 metres long and 200 metres wide, with almost perpendicular walls consisting of ash to a depth of 61 metres below the margin, and still emitting quantities of gas. With the exception of a small corner in the south-west, where the vegetable gardens are still flourishing, the whole island is covered with ash and strewn with

FIG. 4.—TORISHIMA, SEEN FROM THE NORTH AFTER THE OUTBREAK.

lava-blocks. The terraced descent to the bay on which Tamaki-mura stood, has disappeared under ashes, and its place is taken by a steep slope, under which, as may be supposed, the village and all its inhabitants lie buried. The brook (9) is no longer to be found, and a new inlet (5), cut deep into the coast, has made its appearance.

On the south-west coast quantities of hot water issue from a submarine volcano,

or more probably a hot spring (Fig. 2, No. 20). The ash covering the slopes of the mountain is still very hot in places, but there is no other sign of continued volcanic activity.

It may be assumed that the catastrophe was due to the accumulation of gas within the Komochi-yama; the pressure ultimately forcing an outlet by blowing off the top of the mountain, and scattering the material of which it was composed all over the island. This assumption is supported by the facts that no fresh lava has come to the surface, that the outburst occurred quite suddenly, and that there is no indication of continued activity. The suddenness of the explosion may be judged from the fact that not one of the 125 inhabitants saved his life, although several boats were handy. These boats were kept hauled up on the beach because of the heavy surf, and apparently there was no time to get them off. Since no human bodies have been found, only the half-burnt remains of two cows, it may be surmised that the outburst took place during the night (August 9 and 10), while all the inhabitants were in bed. From the present configuration of the position occupied by the village, it would seem that the huge mass blown up by the explosion fell upon it like a blow, and that the annihilation was complete. The absence of ashes on the south-west of the island is no doubt due to the prevailing westerly wind.

THE BRITISH ANTARCTIC EXPEDITION: RETURN OF THE "MORNING."

THE eagerly expected news of the British Antarctic Expedition was received on March 25, when the arrival of the *Morning*, the relief ship of the expedition, at Lyttelton, N.Z., was reported through Reuter's agency, Commander Scott's brief summary of the work so far accomplished being received on the same day. The report shows that, while coming in for their full share of difficulties and hardships, the gallant explorers have already accomplished an amount of excellent work which justifies us in considering the general results of the expedition as thoroughly satisfactory. One of the officers, Lieut. Shackleton, is, we regret to say, coming home invalided, having suffered much from exposure during an arduous sledge expedition; while one of the seamen was unfortunately drowned by falling from a cliff during a blizzard. Otherwise the health of the party appears to have been good, in spite of some privation experienced before the arrival of the *Morning* through the deterioration of some of the supplies. The *Discovery* has revictualled from the *Morning*, and is remaining in the Antarctic for another winter; we may thus hope that considerable additions will be made to the results already gained.

The telegraphic summary naturally leaves some points obscure, and we must depend to some extent on conjecture in piecing together a connected account of the doings of the explorers. This is especially the case from the fact that the field of the explorations is traversed by

the 180th meridian, and a distinction is not always made between the longitudes on the two sides of this line. The pack was entered early in January, 1902, in lat. 67°. After visiting Cape Adare, Wood bay, and an excellent harbour in lat. 76° 30′, a record of the voyage was left at Cape Crozier on January 22. The *Discovery* then followed the ice-barrier eastward, and in 165° it was found to trend northward, the water becoming shallow. From the edge of the barrier high snow-slopes rose to an extensive, heavily glaciated land, with occasional bare and precipitous peaks. The coast-line was followed to lat. 76°, long. 152° 30′, or quite 150 miles beyond the furthest previously reached in this direction.

Returning, the ship put into an inlet in the barrier in long. 174°, and a sledge-party examined the land as far as 78° 50′ S. Excellent winter quarters having been found on an island near Mounts Erebus and Terror, the coast of Victoria Land was examined as far as a conspicuous cape in 78° 50′ S., where, contrary to previous statements, mountains do not exist. The ship was frozen in on March 24, and, in spite of boisterous weather, the expedition passed a comfortable winter in well-sheltered quarters. The lowest temperature recorded was 62° below zero. Sledging commenced on September 2, and a record was established by a party under Lieut. Royds and Mr. Skelton during a trying expedition to Mount Terror; while Commander Scott, Dr. Wilson, and Lieut. Shackleton travelled 94 miles to the southward, reaching land in lat. 80° 17′ S., long. 163° W.,* thus attaining the farthest south ever reached by man. The journey was accomplished in most trying conditions. The dogs all died, and the three men had to drag the sledges back to the ship, this being the occasion on which Lieut. Shackleton nearly lost his life through exposure. Victoria Land was found to be traversed by ranges of high mountains, which in 82° reach a height of 10,000 to 12,000 feet. Foothills resembling the Admiralty range were found in 160°, and a party ascending a glacier reached an unbroken level plain at an altitude of 9000 feet. The coast-line was seen to continue nearly due south to at least 83° 20′ S. Commander Scott considers that the ice-barrier, which continues horizontal, is afloat, though slowly fed from the land-ice.

The chief point left obscure in the above account is the continuity or otherwise of the easternmost land seen, which was traversed by a

* It is probably safe to conclude that the direction of this longitude is west from the 180th meridian, to which initial line the explorers, like their predecessors in this region, would be naturally inclined to refer their movements, though the amount of the longitude is, of course, reckoned from Greenwich. In all previous cases the longitude has been given without statement of direction, and the positions appear to lie east of 180°, or in longitude *west* from Greenwich. In mentioning the direction here, Commander Scott would seem to emphasize the fact that the longitude is on the opposite side of 180° to those previously given.

sledge-party to 78° 50′ S., with Victoria Land. Probably the data obtained did not permit of an answer being given to the question, but in any case a deep gulf appears to run south, in the intermediate area, to beyond 83°. In addition to the purely geographical results, the work of the expedition has included important observations in the field of marine biology, magnetism, oceanography, meteorology, seismology, etc. Geological data were also obtained, and a number of excellent photographs taken.

Since the above was written it has been ascertained that Captain Scott, on his sledge expedition, reached 82° 17′ S. instead of 80° 17′.

ADDITIONAL REMARKS ON NEW DISCOVERIES IN THE TEXT OF CARPINI.

The question of the original manuscript authority for the 'Historia Mongalorum' of John de Plano Carpini has been still further complicated by the extraordinary oversight which has made two manuscripts out of one, at the same time that one of the two most important, oldest, and best copies was passed by altogether. For while on one hand the Corpus manuscript (No. 181) was never collated or examined, on the other hand the copy once in Lord Lumley's possession and known as the Lumley manuscript, from which Hakluyt copied (with mistakes enough) his text in the 'Principal Navigations,' appears to be no other than the identical copy now in the British Museum (Reg. 13 A xiv.) known as the London manuscript. The 'two' differ in this only: 'Lumley' is the text with Hakluyt's mis-readings; 'London' is the same text, the same copy, as more accurately read by nineteenth-century scholars. Owing to the oversight of Thomas Wright, when he collated, or professed to collate, the English manuscripts of Carpini for d'Avezac's edition of 1838 (reprinted, 1839, in the *Recueil;* this last being the form usually quoted), readings from 'Lumley' and 'London' appear together, in agreement or in opposition, upon nearly all the pages of the standard edition of the great traveller (see the *Recueil de voyages et de mémoires publié par la Société de Géographie*, vol. iv., 1839). The London manuscript is known to have come into the possession of the British Museum with the other Lumley manuscripts. In evidence of its origin, the flyleaf, folio 1, recto, bears the names of 'Arundel' and 'Lumley' written in a stiff hand at the foot of the page.

As to the 'new' or at least hitherto unexamined manuscript of Carpini in the manuscript vol. No. 181 of the Corpus Christi College collection in Cambridge, a manuscript which we may best call 'Corpus,' and which (as already pointed out) is the same as the manuscript called by old catalogues 'Bennet College No. 61,' a further examination enables me to add some remarks to those I have already made in the *Geographical Journal* for December, 1902. There are, in all, thirty-two passages, longer or shorter, which may be called author's additions, found only in the Corpus (or Cambridge) and the Petau (or Leyden) manuscripts. In all of these the similarity of the two is close: the differences are rarely more than verbal. It is, perhaps, in the chapter headings that most variations are to be found, and even here the variations are not numerous or considerable. Carpini's four great name-lists—of the Mongol princes, of the nations subdued by the Mongols, of the

nations that had successfully resisted them, and of the witnesses to the veracity of his narrative—the last a catalogue which includes all the Italian merchants whom Friar John could remember as trading at Kiev on his return in 1247—are identical in the Cambridge and Leyden manuscripts, whose relationship is unquestionably that of sister texts.

C. Raymond Beazley.

REVIEWS.

ASIA.

China and Japan.

'On the Coasts of Cathay and Cipango Forty Years ago.' By William Blakeney, R.N. London: Elliot Stock. 1902.

The author gives some interesting reminiscences of survey work on the coasts of China and Japan in which he took part during the years 1856–62. In the course of the operations in the far East during the Crimean war, the ignorance which then prevailed on the hydrography of those regions (the island of Sakhalin was still supposed to be connected with the mainland) had much hampered the movements of the British fleet, and it was therefore resolved, on the conclusion of peace, to despatch a surveying ship for the proper charting of the coasts. The choice fell on the sailing frigate *Actæon*, which was placed under the command of Captain W. Thornton Bate (killed in 1857 at the taking of the Canton forts), Mr. Blakeney serving as one of the survey officers. During the commission of the *Actæon* important surveys were carried out in many parts of the eastern seas, of which accurate charts were thus for the first time made available. The interest in the book lies chiefly in the means of comparison it affords between those days and our own, both as regards the countries and politics of the Far East and the life on board the ships of the British navy. Many of the events are, of course, well-known history, but the personal element in the narrative gives it some freshness. Mr. Blakeney considers that modern events in the East threw their shadows before them, even at that distance of time, and he shows that the recent Russian advance really had its first beginning in those days. Among the coasts and ports surveyed by the *Actæon*, one of the most important was the sound on the west coast of Tsusima, on the strategical importance of which the writer again and again insists, and which the Russians made an abortive attempt to occupy in 1860. It was a fact frustrated largely through the arrival of the *Actæon*. The book is illustrated by some spirited sketches by Mr. Blakeney's brother officer, Mr. Bedwell, as well as by copies of Chinese and Japanese pictures, charts of the coasts, and various early drawings and photographs.

AFRICA.

East Africa.

'Two African Trips, with Notes and Suggestions on Big Game Preservation in Africa.' By Edward North Buxton. London: Stanford. 1902.

In this volume Mr. Buxton puts before the public his field-notes taken during two holiday trips, made chiefly for purposes of sport, the one in British East Africa, the other on the White Nile. Of geography pure and simple it naturally contains little with any title to novelty, but the book has special claims to

notice from another point of view. The author is not a mere slayer of big game, but an enthusiastic student of the habits and life-conditions of living beasts and birds. He has, for the first time, made a serious attempt to photograph African wild life amid its natural surroundings, and the very successful results (when we think of the difficulties which such an attempt must involve) are given in the present volume in a most interesting series of pictures. The absorbing interest of the "camera-stalks" necessary to secure these results can well be imagined, and Mr. Buxton insists with justice that a successful picture of wild life is a higher achievement, even in the realm of mere sport, than a trophy, however imposing. Now that he has led the way, we may expect that other travellers will follow suit, and a new interest will thus attach to many of the future narratives of African travel. Mr. Buxton is deeply interested in the question of the preservation of the larger species of African wild animals, and both his remarks on the subject, and his map on which all the game reserves of the British protectorates in East Africa are laid down, are of value in this connection. He clearly shows that the mere marking off of such-and-such areas as reserves is not enough, but that careful attention must be given to the surrounding conditions, the needs of the game, and especially their periodical migrations. Besides the photographs of living birds and beasts, there are others which illustrate native life, types of scenery and vegetation, etc., some of the river-bits in British East Africa being particularly striking.

AMERICA.

Colonial History.

'New France and New England.' By John Fiske. London: Macmillan. 1902.

This volume was intended by its author, the late Mr. Fiske, to complete the series of historical works already published by him on the history of the North American colonies. The early history of the United States had been dealt with in the two volumes, 'The Beginnings of New England,' and 'The Dutch and Quaker Colonies in America,' while the more recent part of the story had been told in his 'American Revolution.' The intervening period was marked above all by the increasing rivalry between France and England in North America, and its final arbitrament by the victory of Wolfe. In the present volume, therefore, the author traces the growth of New France from the time of Cartier and Champlain to La Salle, and then describes the development and gradual extension westwards of the British colonies, which led to constantly increasing friction between the two nations. Much of the story has, of course, been often told before, in the writings of Winsor, Parkman, and others, but many readers will no doubt appreciate the opportunity of learning the salient facts of the struggle within the convenient compass of Mr. Fiske's narrative. The fifth and sixth chapters seem, perhaps, hardly to fall into line with the rest, as they treat solely of the internal condition of the British colonies, mainly from the point of view of religion. There are several reproductions of early maps, while references to other authorities will help those who wish to pursue the subject further.

South America.

'Down the Orinoco in a Canoe.' By S. Pérez Triana. London: Heinemann. 1902.

This gives a somewhat slight and popular account of a journey from Bogotá to the Orinoco and down the course of that river to its mouth. The author, son of an ex-President of Colombia, was, during one of the periodical South American revolutions, forced to seek safety in flight, and the only way open for this was that across the vast forests which stretch eastward from the foot of the Andes. The

journey appears to have been made some years ago, though dates are eschewed throughout. This, however, is of the less importance that the region traversed is one of the least-known recesses of the continent, and its picture can vary little in the course of a few years. It is, in fact, this very remoteness from the world, of these interior fastnesses described in its pages, which gives to the book an interest it would not otherwise possess. The author waxes eloquent in his descriptions of the vast forests and mighty rivers which lay on his route, though to English ears his language may sound somewhat flowery; while the printing of a laudatory preface by another hand—an objectionable practice which has become too common of late—is by no means a recommendation.

OCEANOGRAPHY.

Atlas of the Atlantic Ocean.

'Deutsche Seewarte: Atlantischer Ozean. Ein Atlas von 39 Karten, die physikalischen Verhältnisse und die Verkehrsstrassen darstellend. Mit einer erläuternden Einleitung und als Beilage zum Segelhandbuch für den Atlantischen Ozean.' 2 Auflage. Herausgegeben von der Direktion. L. Friederichsen & Co., Hamburg. 1902.

When the second edition of the 'Segelhandbuch für den Atlantischen Ozean' was published in 1898, it was stated that the publication of the Atlas belonging to it would be delayed until it was possible to incorporate in the maps the results of a number of investigations then in progress, especially those of the great "Zehn Grad-Quadratarbeit," and of the *Valdivia* expedition. The work has now been completed, and the atlas was issued at the end of last year. The maps, which are drawn on Mercator's projection, have been reproduced by Wagner and Debes, and are without exception excellent specimens of cartography. The chart of depths (No. 1) shows very strikingly how greatly recent soundings have modified our conception of the relief of the bed of the Atlantic; it is practically a reduction of the admirable equal-area map compiled by Dr. G. Schott for the report on the *Valdivia* expedition. Sheet 2 shows the temperature of water at 400 metres below the surface.

In sheet 3 the surface currents and distribution of drifting ice and weed are shown for mid-winter of the northern hemisphere. This map, which has been drawn up by Prof. Krümmel, is particularly important, as it represents generalizations from observed facts rather than, as in the case of most of the others, simply the facts themselves. The problem of drawing a satisfactory current chart still remains, it seems to us, to be satisfactorily solved. Nearly all are much too suggestive of "rivers in the oceans," and in some respects we prefer the wavy arrows of the Meteorological Office Current Charts to the stream-lines of this atlas. The marking of regions where "drift" currents predominate by a special colour is an excellent feature, although we should have expected to find part of the equatorial belt so marked, as well as the extra-tropical west-wind areas. While it is true in a certain sense, as Prof. Krümmel says, that the general current system in the Atlantic undergoes little seasonal variation, we can hardly agree that the winter chart serves quite satisfactorily for the whole year. The drift circulation shown on the map for the North Atlantic closely represents the average state of affairs in winter, but in summer the general movement in the belt, say, between lat. 50° N. and lat. 60° N., is more from the west, while on the eastern side the northerly movement is frequently absent, and sometimes, at least, is altogether reversed between Iceland and the British Isles.

The four following maps, Nos. 5 to 8, show the distribution of surface temperature for the months February, May, August, and November. Sheet 9 gives the mean annual temperature of the air, and sheet 10 the temperature for the four months, over the whole Atlantic basin. These last are particularly valuable, as they extend from long. 100° W. to 30° E., and include all South America, and parts of Europe, North America, and Africa. The next two sheets give the air-temperatures for each month over the oceanic area alone; all these maps are new, and depend largely on the "Zehn Grad-Quadratrabeit." Sheets 13 to 16 deal similarly with atmospheric pressure, the material being derived from the same sources. Next follows a series of charts illustrating the general meteorology of the Atlantic, the most complete and exhaustive series of its kind in existence, and one which will well repay the study of every teacher of geography, as well as of every student of special climatology. It is unnecessary to give the full list of the maps, and it is difficult to single out any as of special value, but without prejudice to the others we may mention the plate showing weather types, from Köppen and van Bebber's well-known papers; the maps of duration and direction and mean change of wind-direction of storms, from the important paper published by E. Knipping in the *Annalen der Hydrographie* for August, 1901; the chart of mean frequency and tracks of cyclones in the North Atlantic; and the rainfall charts.

The last section of the atlas includes three maps showing the magnetic elements for 1902, two showing the chief routes for steamers and sailing vessels during the winter and summer months, and one by Dr. H. Bolan showing the distribution of the chief species of whales, with the fishing-grounds.

H. N. D.

GENERAL.

The Geographer at High Altitudes.

'Climbing on the Himalaya and Other Mountain Ranges.' By J. Norman Collie, F.R.S. Edinburgh: David Douglas. 1902.

In this volume Professor Collie has given us something of his mountaineering experiences in many lands. Portions of the book are not entirely new, having appeared in other guise, to wit in the pages of the *Alpine Journal* and in the publications of the Scottish Mountaineering Club.

Although nominally addressed to the mountaineer, the work is full of interest to the geographer, and is illustrated by some fine photogravures from the author's negatives. The most important portion of the book is undoubtedly that dealing with the Himalaya, which occupies the first half of the volume. After an introductory chapter on the history of mountaineering in India, the author carries us away to his own special district between the Astor river and the Indus, where the Diamirai, Rupal, and several minor glaciers cluster on either flank of the lofty Nanga Parbat range. In this introductory chapter we have an interesting epitome of the chief ascents and expeditions in various parts of the range. In this connection it is interesting to note that the author accepts Mr. Graham's account of his ascent of Kabru (24,015 feet) in the Kangchenjunga range, summing up the evidence in the following sentence: "Any one who will take the trouble to read his account of the ascent of Kabru, cannot fail to admit that he must have climbed the peak lying on the south-west of Kangchenjunga, viz. Kabru, for there is no other high peak there which he could have ascended from his starting-point except Kangchenjunga itself. . . . Now, if they climbed Kabru, they were at a height of 24,000 feet whether they had a barometer with them or not, for that is the height determined by the Ordnance Survey." In this conclusion he agrees

with Mr. Freshfield, who visited the peak in 1899, and Kabru must in future be placed first in the catalogue of mountain ascents as the highest point on the Earth's surface yet attained by man. One of the chief arguments urged against this ascent was the assertion that Graham makes practically no reference to the pangs of mountain sickness, which it is assumed he must have felt acutely at this altitude. Our author's experience in this respect agrees with that of Sir M. Conway, Mr. Freshfield, and others who have visited the Himalayas of recent years. Only once did the party on Nanga Parbat experience any real ill effects from this cause, and that was, as in similar cases, at a height below 18,000 feet.

This expedition to Nanga Parbat, undertaken in 1895 with Mr. G. Hastings and the late Mr. A. F. Mummery, is a record of a very plucky attack, without the assistance of professional guides, on a difficult and isolated range. Between July 17 and August 24, the party ascended the Diamirai peak (19,000 feet) and crossed the Diamirai pass (18,000 feet) and other minor passes in the range, while a height of 20,000 feet was reached by Mummery and Ragobir on Nanga Parbat, and 21,000 on the rocks above the Mazeno pass by Mummery and Hastings. Altogether the climbing appears to have been of the severest kind, and the ascent of Nanga Parbat does not seem to be any nearer immediate realization than that of Kangchenjunga or K_2. The sad accident which brought this expedition to a sudden conclusion is now well known. In attempting to cross the Diama pass, Mummery, Ragobir, and Gorman Singh disappeared for ever, having most likely, it seems, been overwhelmed by an avalanche falling from the north face of Nanga Parbat. Thus perished the most brilliant amateur climber of his day, and one who had but few equals among professional mountaineers.

The chapter which follows on the Canadian Rocky mountains forms a charming introduction to the mountain geography of this little-known region. The nomenclature of peak and glacier on the accompanying map shows that here, as elsewhere, the English mountaineer is still to the fore, such names as Freshfield, Bryce, Dent, Stutfield, and Mummery speaking for the nationality of the explorer in no uncertain voice, while the fact that, with one sad exception, they are names of living and active mountaineers testifies to the recent date of their discovery. We have only one fault to find with this chapter, and that is that it is all too short. We feel that the reader has been mentally jilted; he has been led on to admire this fair country, the description of which has been clothed in most attractive garb, only to find himself excluded in the end from more intimate confidences. He would like to have heard more of that interesting group the Colombia range, discovered by the author and his party in 1898, of the characters of the group, and the nature of the climbing they afford. But perhaps, if rumour is to be trusted, the author, like a skilful cook, has merely whetted the appetite of his readers by an *hors-d'œuvre*, to be followed by a joint work dealing exclusively with this fascinating country.

In the chapter on the Lofoten islands, the author shows himself a master of terse analysis; thus, in speaking of the characteristic scenery produced by ice-erosion, he very happily describes the country as having been "worn to the bone"—that is, suffered the removal of its softer superficial covering: a truer description of ice-work than the author perhaps intends, for, in speaking of the Ofaten fjord, he mentions "valleys whose sides for miles are perpendicular walls of rock, sometimes a couple of thousand feet high, and which have undoubtedly been excavated and then polished by the power of ice." With due deference to the distinguished author, we would like to query the "undoubtedly," especially as we read in the same paragraph, "On Nanga Parbat I have seen a vast glacier turned to one side by its own moraine;" and we would like to recall the fact that the same phenomenon has

been frequently described recently from "an arctic ice-sheet such as that on Greenland" or Spitsbergen.

The remaining chapters are, perhaps, less geographical in their aim. The chapter on the Alps (giving incidentally an account of one of the author's most brilliant ascents with Mummery up the Brevna route of Mont Blanc) should be read by all who affect to despise this cradle of the mountaineering race. It contains some of the best-written pages in the book. In spite of modern innovation, the Alps will retain their splendid fascination for many a year to come. "The overhanging cornices high above, for ever on the point of breaking off, will still hang poised in unstable equilibrium. The storms will sweep as frequently as of old across that mountain land, holding for a brief space all in gloom; the lightning-flashes, the roar of the thunder, the driving snow, and the keen biting wind will hunt the too presumptuous climber back to lower altitudes, as they have done often before; and afterwards the sun will shine again, dissolving the clouds, drying the lower slopes, and showing how the old mountains have once more put on a clean garment, which, in magnificence, in glittering splendour, is as unmatched or unequalled as the deep glowing colour of that 'solitary handmaid of eternity,' the open ocean, or the glories of the heavens at dawn or at sunset."

The author's passion for sunsets is very marked, and gives rise to some of the finest passages in the book, and his feeling for scenery is evinced in every page. What could be more graphic than the following description of the Lofoten islands?—"For those who care to climb where great expanses of sky and clouds arch slowly down to the far-off horizon, and where lonely islands are set in open spaces of blue water, those remote Lofoten mountain fastnesses beyond the arctic circle are difficult to equal. The low circling sun making it for ever afternoon, flooding sky and mountain land in warm luminous colour, which deepens the distances, and adds perspective to ridge after ridge of serrated and barren peaks."

Though the description of actual mountain ascent is limited to a few portions of the book, every page breathes out the spirit of the everlasting hills, the attar of mountain memories distilled from the soul of one of Nature's truest worshippers. It is indeed a charming book.

E. J. G.

THE MONTHLY RECORD.

THE SOCIETY.

The Awards for 1903.—The Royal Medals and other premiums of the Society have been awarded this year as follows: The Founder's Medal has been assigned to Mr. Douglas W. Freshfield, in recognition of his valuable contributions to our knowledge of the Caucasus, both by his journeys and writings, and for his recent explorations round Mount Kangchenjunga. It is also intended as a mark of appreciation of his persistent efforts in behalf of the improvement of geographical education. The Patron's Medal will be given to Captain Otto Sverdrup, for his important discoveries in the Jones sound region during his recent arctic expedition, as well as for the important part which he played as captain of the *Fram* during Dr. Nansen's famous expedition. The award of the Special Victoria Medal, given for geographical

research, to Dr. Sven Hedin, has already been announced in the *Journal*, as it was made during the recent visit of the explorer to this country. The Murchison Grant has been awarded to Mr. Isaachsen, Captain Sverdrup's right-hand man during his recent expedition, to whom many of the geographical discoveries made by the expedition were due. The Back Grant goes to Dr. W. G. Smith, for his investigations into the geographical distribution of vegetation in Great Britain; the Gill Memorial to Mr. Ellsworth Huntington, for his remarkable journey through the great cañon of the Euphrates, described in the *Journal* for August last; and the Cuthbert Peek grant to Major J. A. Burdon, for his excellent route-surveys in Northern Nigeria.

EUROPE.

A German Critic of the Ordnance Survey Maps.—In explaining, in a recent number of *Petermanns Mitteilungen* (1902, No. 10), the method adopted in the preparation of the new map of the British Isles for Stieler's Handatlas, Herr Koffmahn indulges in some criticisms of the English Ordnance maps, which are for the most part quite unfounded. His statements are, indeed, in many cases, so wide of the facts as to be quite inexplicable, except on the supposition that he has consulted some out-of-date sheets of the old edition; but as he shows himself in many respects conversant with the latest developments in the work of the Survey Office, it seems that this explanation cannot hold good. The criticisms are in many cases general ones, no specific instances of the alleged defects being quoted, so that it is impossible to reply to them except by an equally general negative, but there are also some definite statements, the incorrectness of which will be evident to all who are acquainted with the Ordnance maps. Thus, with reference to the 1-inch map, we are told that many sheets of the so-called "revised" maps date back thirty to forty years, the revision having taken place a generation ago. As a matter of fact, as may be seen from the date printed at the foot of each map, the oldest sheet was revised considerably less than ten years ago, while most of the sheets have been revised much more recently. Changes in county boundaries, in regard to which a complaint of inaccuracy is made, are inserted at each revision, while new railways are inserted from time to time as they are opened for traffic. To the statement that considerable towns of recent growth are still shown as villages, and that some populous industrial centres are represented as mere farms, it is obviously impossible to reply in the absence of any citation of instances. Herr Koffmahn appears to derive his ideas in many cases from criticisms which have been made in this country, failing to see that, even if true when first put forward ten to sixteen years ago, the subsequent revision has rendered them quite inapplicable at the present day. It is somewhat singular, also, that among the sources by which, as he says, he was obliged to supplement the maps of the Ordnance Survey, he should give a prominent place to Bartholomew's 2-mile map of Scotland, though this is itself avowedly based on the Ordnance maps. The criticisms on the inferior methods of hill-representation in vogue in this country are probably not intended to apply to the Ordnance maps—if so, it would be a sufficient answer to point to the 1-inch hill maps of the mountainous districts of Scotland, etc.—but rather to maps for use in schools. But, while allowing that these have been far from satisfactory in the past, and may still leave room for improvement, we hardly think that Herr Koffmahn is acquainted with the better class of school maps which have come into use within recent years. He expresses the hope that his own map of the

British isles may be largely used in this country as well as in Germany, and it cannot be denied that it gives an admirable general view of the surface features of the country—probably the best in existence, considering the size of the map. It is to be regretted, however, that the scale (1 : 1,500,000) is far too small to do adequate justice to the more thickly populated districts.

Afforestation in the Black Country.—A society for promoting the afforestation of the Black Country was recently inaugurated by a meeting held at Birmingham, at which Sir Oliver Lodge presided. It is a common idea that the large area in this district covered with ash-heaps and other *débris* is necessarily condemned to remain in a state of hideous barrenness, but it is satisfactory to find that such is not by any means the case. Commenting on the recent meeting, Prof. Schlich mentions, in *Nature* for February 26 last, an instance from the Belgian Ardennes, in which old slag and ash-heaps were found by him well stocked with oak and ash trees, some of them of considerable size, and he states that it was the knowledge of this fact which suggested to Mr. W. R. Fisher, to whom the credit of bringing it forward belongs, the idea that the Black Country might be utilized in the same way. The area with which it is proposed to deal is said to be some 14,000 acres, now covered by some extent by grass, and grazed over by sheep ; but if systematically planted, the advantage both from a utilitarian and æsthetic point of view could not fail to be important. In these days, when practical considerations alone are so apt to carry the day, it is pleasant to find that the less tangible results of such afforestation in the direction of improving the moral and æsthetic conditions of life in the Black Country met with due appreciation at the meeting. Prof. Schlich urges that the whole undertaking should be placed under the control of a single body representing the various interests involved, and suggests fast-growing conifers as the most suitable trees for planting.

The Diois and the Baronnies.—This region, which is described by M. Paquier in *La Géographie*, October to December, 1902, occupies the eastern part of the department of the Drôme between the plateau of Vercors in the north, Mount Ventoux and the ridge of the Lure in the south, Devoluy and Gap on the east, and the forest of Saou and Nyons on the west. The dividing-line between the Diois in the north and the Baronnies in the south is between Mount Angèle and Serres. Throughout the region synclinal elliptical valleys are characteristic. In the south they lie east and west, with a sharp deflection to the north on the extreme western end, whereas in the Diois the whole western region, with the exception of the forest of Saou, has the synclines stretching from north to south. The east-and-west direction is the older, and represents the pre-oligocene foldings which characterize the Pyrenees and Provence. The north-and-south synclines are due to post-Miocene foldings of the Alps, which are alone met with in the Vercors and the Chartreuse farther to the north. The region is therefore an intermediate one, becoming more and more provençal from north to south. The alternation mainly of harder and softer limestone determines scarped landscapes where they are not too steeply tilted, and series of saw-toothed ridges where the dip is nearly vertical in the anticlinal areas. The establishment of a stable drainage system in such a region of synclinal hollows sharply defined and surrounded by anticlinal ridges, can only be brought about when the anticlines are sufficiently worn down to become the seat of the principal streams. In the Baronnies a mature hydrographical system exists, but the successive stages of its evolution are often impossible to trace, while in the Diois, where recent tectonic movements have had greater play, especially on the western side, the mature condition has not been reached, and capture phenomena are easily recognized and testify to its less evolved condition. The western Baronnies are drained by the

Eygues and the Ouvèze to the Rhone. They rise in large downfolds, in which they flow from east to west; but in the west they turn to the south-west at right angles to the tectonic features of alpine trend across the transverse depression where the fold axis changes its direction. The eastern Baronnies were also originally drained to the west, but the wearing down of the upfold (in which glaciation played a part) along which the Buech now flows, has transformed the synclinal Méouge and Orpierre into obsequent rivers, while the westward flowing Lauzence, a tributary of the Méouge, is a relict of the old consequent system. In the Rosans valley this development is not so complete, for the greater part is still drained westwards by the Egyues. The hydrography of the Diois is less mature. Eliminating the small part tributary to the Bueche and the south-east of the Valdrôme, the Diois is surrounded by upfolds with only two openings to the exterior of the Alps, the one used by the Oule, which drains the south, and that of the Drôme in the north. The course of the Drôme from south-east to north-west is determined by the folds, which are compounded of the east-west and north-south trends; from Die to Espinal it curves round the anticlinal margin of the north of the Diois plateau, but after passing the gorge at Verchery, it runs almost due west to the Rhone, parallel to the axis of the forest of Saou, but cutting across a transversal depression in the north-south folds which it crosses on the way as far as Crest. Its course here may be compared with that of the Eygues above Nyons. The valley of the Charce presents an admirable example of an asymmetric synclinal area, and in it the subsequent streams are of great importance. The Oule, which drains this valley, begins as a consequent torrent, but the synclinal axis is not followed by it, and the chief exit from the valley is by a subsequent channel at right angles to the synclinal axis. In the upper Jurassic limestone the irregularities of the gorges cannot be explained by external denudation, and it is necessary to take into account subterranean erosion.

Prof. Cvijić's Investigations in the Balkans.—With the object of completing his researches in the eastern and central parts, Prof. Cvijić has made explorations in the mountain region of the Balkan peninsula. During the last seven or eight years he has crossed it at forty different points, distributed over its entire length from the Zajecar basin in Servia to the Black sea; but the greater number of these crossings were made in the summer of 1902, and further excursions have been made to the Karadža mountains and the Istrandžadagh. As a result of these journeys considerable additions have been made to the geological maps, numerous sections have been drawn, and lines of folding determined. The relation of the Jaila mountains to the Balkans has been elucidated by an expedition to the Crimea, which permitted a study of the tectonic conditions of the coast ranges in that peninsula. Prof. Cvijić is now working up the large amount of material he has collected, and attaches special importance to the preparation of tectonic maps of the region where the Transylvanian Alps (between Hungary and Rumania) merge with the western Balkans, of the district to the south of the Iron Gates, and of the central and eastern parts of the long Balkan chain. The sections are also being elaborated on a large scale. We are informed that the observations in a number of places have been found to be still inadequate, and that Prof. Cvijić intends to remedy the deficiencies by further explorations next summer. The chief results of the investigation will be communicated to the International Geological Congress to be held at Vienna at the end of August, and the memoirs will be published by the Vienna Academy of Sciences.

The Middle Urals.—The second part of vol. xxxiv. of 'Mémoires de la Société de Physique et d'Histoire Naturelle de Genève' embodies the results of work by Prof. Louis Duparc and Dr. Francis Pearce in the district of Rastesskaya

and Kizilovskaya-Datcha, in the government of Perm. The region is watered by the upper Kosva and its feeders. This river is one of the numerous tributaries that flow westward to the Kama from the low hills of the Middle Ural, and joins the main river some hundred miles above Perm. The structure of this portion of the Ural system is of a highly complicated nature; its main lines run along parallel chains running north-east and south-west in the northern portion, but the general trend swings to south-east in the southern. The elevation is of course not great, the highest point reaching little over 4000 feet. The vegetation consists of dense coniferous and deciduous forests, while the valleys are exceedingly fertile. This section of the Ural system also includes the wealthy mineral workings which have their main market at Ekaterinburg. The particular section of the country worked by Prof. Duparc and Dr. Pearce is here described in very full detail. The orographical and hydrographical features are first considered, accompanied by a sketch of general conditions—flora, fauna, population, and the rest. We observe from the admirable illustrations which accompany this section how little the Ural system approximates to the appearance of a mountain range proper, which is usually accorded to it in maps. It appears in these photographs as a succession of low upheavals exactly of billow form—long slow swells succeeding one another in a regular alignment. The rivers are not particularly rapid, but are shallow, and offer no great facilities for regular communication, which, in effect, is difficult by any means. The travellers note how the long "pirogues," though of the lightest draught, frequently ran upon shoals. The second and third parts of the treatise are concerned, in the closest detail, with the geology of the two hills to which the travellers confined their most careful attention. The Urals present a considerable geological uniformity; the main axis, always on the eastern side of the upheavals, consists of a strip mainly composed of granites, porphyries, and rocks of a kindred nature, while the long western descent, with which we are concerned, has coverings from Silurian to Triassic. Thus a detailed examination of certain points is of value, and the careful analysis to which Prof. Duparc and Dr. Pearce have subjected the peaks of Koswinsky mountain, and the lesser height of Katéchersky, will prove of the greatest interest to close students of geology.

ASIA.

Tidal Periodicity of Earthquakes in Assam.—The idea that the relative frequency of earthquakes may be influenced in some way by the action of the Sun, Moon, or planets on the Earth has long met with attention on the part of scientific men, as a result of which certain generalizations have been put forward, as, *e.g.*, that earthquakes are more frequent in winter than in summer, and by night than by day. The laborious researches of M. Montessus de Ballore, who based his conclusions on a study of 45,000 earthquakes, seemed to show that when large numbers like these were considered, the periodicity apparent in individual lists tended to disappear; though, on the other hand, Dr. Davidson showed that within definite regions there is a distinct seasonal variation. Mr. R. D. Oldham, of the Geological Survey of India, has lately made a study of the records of earthquake shocks in Assam, which have been kept since 1897, the year of the great earthquake in that province; and the results of his inquiry are put forward in the *Journal of the Asiatic Society of Bengal*, vol. lxxi., 1902, pp. 139–153 (also issued as a reprint). Mr. Oldham points out that any effect which the attraction of the sun and moon may have will be mainly exerted by the tide-producing forces they set up, and he therefore briefly sketches the way in which these are exercised. If, he points out, we suppose the force exerted at any point to be resolved into two separate forces—one vertical, the other horizontal, the vertical force attains

its upward maximum where the satellite (the sun as well as the moon is regarded as such for the special purposes of this investigation) is in the zenith or nadir, and its downward maximum along the great circle at right angles to the line joining these points; while the horizontal force attains its maximum along two circles distant about 54° 44′ from the zenith and nadir respectively. Mr. Oldham then calculates, for 26° N., and for different declinations of the sun, the intervals, before and after midday and midnight, of the passage both of the circles of maximum tide-producing forces, and (which may be still more important) of the maximum *rate of change* of such forces; afterwards examining, side by side with the results, the actual *data* as to earthquake frequency which have been obtained. Into the details of the inquiry we cannot enter, but the general result is to show (1) that earthquake shocks in Assam were most frequent between 10 and 11 p.m., and between 6 and 7 a.m., though no satisfactory cause can be assigned for this distribution; (2) that there is another and smaller variation which has the appearance of being due to the tidal stresses set up by the attraction of the sun; and (3) that if this is really the case, the horizontal stress is much more efficient than the vertical, and the rate and range of variation of the stress, than its actual amount. These conclusions are to be regarded as provisional only until observations over a longer period are available.

The Dalai Lama's Residence at Potala.—Mr. Douglas Freshfield sends us the following note on a new representation of the Dalai Lama's palace: "Mrs. Le Mesurier, the wife of the English Resident in Ladakh, has sent me from Leh a photograph of an original drawing of Potala, the residence of the Dalai Lama at Lhasa, taken from an original drawing given to her by a Buddhist lama in Ladakh. The view is taken from the same direction as that published with Chandra Das's narrative, but appears to be somewhat more skilfully drawn, and while confirming the accuracy of the published print adds some additional details."

The Desert of Gobi between Hami and Suchau.—Dr. Futterer crossed this region in his journey through Asia, and has described it from a geographical point of view in considerable detail in the last number of the *Ergänzungshefte of Petermanns Mitteilungen* (No. 139), 1902. There are three different belts—(1) the northern flat depression, extending roughly from east to west; (2) the middle mountain zone of the Pe-shan; and (3) a southern longitudinal depression between the Pe-shan and the Nan-shan. The northern depression lies to the south of the Karluk-tag branch of the Tian-shan, is some 65 kilometres wide, and rises from 840 metres at Dachwantan, south of Hami, to 1700 metres, at the northern foot of the Pe-shan. Towards the west it deepens, to Shona-nor it rises, to sink again to the depression of Turfan. It is mainly covered with waste derived from both northern and southern mountains. Here and there are patches of loam and spots of vegetation where the water reaches. Slight elevations of old volcanic origin rise above the waste deposits, which overlie Tertiary fresh-water sediments as far as can be observed. The base of the Pe-shan or Bei-shan mountain zone is 1700 metres on the north, 1400 in the south, and 2130 metres in the centre. It consists of five more or less parallel ranges striking east-north-east and west-south-west, separated by wide, flat longitudinal troughs. The northern range is a continuation of the Chol-tag of the Tian-shan, and the southern is the easterly prolongation of the Kuruk-tag, which trends to the Tian-shan south of Bagrash-kul and Korla. The four middle ranges rise about 500 metres above the sockle—that is, about 2500 metres above the sea. The structure of this zone is complicated. It consists of old fold mountains, crystalline schists, and metamorphosed old Palæozoic sediments, broken by extensive Palæovolcanic rocks, granite, and diorite. Granite and porphyry are most important in the northern

and southern ranges. The higher middle ranges have vertical metamorphosed Palæozoic sediments and schists, and coal is found near the eastern route across them. The long wide troughs between the ranges are filled with rock waste, but here and there the old rocks are visible. There is little vegetation. Some grows on the loam in the valley openings, and at the base of the mountains or in the middle of the troughs, but none is found on the old diluvial waste, and only isolated bushes in the young dry valleys. Among the animals are the kulang, or wild ass (*Assinus kiang*), the *Equus Prjevalsky*, the argali (*Ovis poli*), the antelope *gutturosa*, the fox, the hare, and the red grouse. The southern trough is 50 kilometres wide and 1310 metres at the lowest point. It too is covered with waste from the mountains, both from the north and the south, with few elevations of old rock or crystalline schists rising out of it. Near the foot of the Nan-shan deposits of the Pliocene sea are found. Along the watercourses are cultivated oases, grass steppes, on the margin tamarisks, and then the pebbly desert zone. The lakes in the west receive the waters from the Nan-shan, but have no outlet. Those in the east form the Edin-gol, which runs past the Pe-shan zone to Sokho-nor.

The Inland Sea of Japan.—Dr. N. Yamasaki contributes a paper on the Setouchi, or inland sea of Japan, and particularly on its geological history, to the November number of *Petermanns Mitteilungen*. Three main aspects of the subject are dealt with—topography, structure, and the action of the tides. The inland sea communicates with the open ocean by four narrow straits—hence its name Setouchi, contracted from Setono-Uchiumi, "the sea within the straits." It is extremely shallow—the depths are usually less than 60 metres; islands are numerous. The coast-line is very irregular, and the different peninsulas and islands divide the basin into seven parts, named, in order from west to east, Suwô-nada, Iyo-nada, Aki-nada, Bingo-nada, Midzushima-nada, Harima-nada, and Osaka bay (Idzumi-nada). Dr. Yamasaki describes the form and structure of each of these divisions in detail, and an excellent map accompanies the paper. In order to understand the general relations of the whole basin, it is necessary to bear in mind that the Japanese group of islands is constituted by two main arcs which meet in the middle of Hondo and form a *Scharung*. The western half of Hondo and the two large islands Shikoku and Kiushiu belong to the southern arc, which presents its convex side to the Pacific, and consists of an outer and inner zone. The Setouchi is a large fracture subsidence in the inner zone of this southern arc, and the subsidence can be traced north-eastward across the Osaka plain, through the valleys of the Yodo-gawa and the Yamato-gawa, to the Biwa lake in the province of Omi. The small peninsulas and islands, the isolated hill-ranges on the land, and the large island of Awaji, represent elevations dotted over the sunken surfaces. Successive subsidences have been partly filled up, sometimes with volcanic material, sometimes with fluviatile, and only the long picturesque strip of the Setouchi remains submerged. As already stated, the inland sea of Japan is, for the most part, very shallow. Deep holes occur, but these are always found in narrow channels, never in open water. In the Bungo straits, the south-western entrance to the Setouchi, the deepest sounding of 300 mètres has been obtained. From there a trough runs north-eastward to the middle of the Iyo-nada, and in the Aki-nada, which contains many islands, there are many small pools 100 mètres or more in depth. Similar holes are found in the island region between the Bingo-nada and the Harima-nada, and off the three promontories of the Awaji island, which form three narrow straits with the mainland of Hondo and the island Shikoku. A typical channel in the Akashi strait, and two deep holes in the Naruto and Yura straits, are also remarkable. Dr. Yamasaki attributes all these submarine forms to tidal action, and discusses the tidal streams in the various channels in detail.

The Latest Crossing of Celebes by Messrs. Sarasin.—We referred a few months ago (vol. xx. p. 229) to the latest journey of exploration undertaken in Celebes by Messrs. Sarasin, and to the project formed by the explorers of a journey across the little-known regions in the western centre of the island. A note in *Globus* for January 15 announces the successful completion of this journey, which was made from Palu (Palos), on the west coast, to Paloppo, on the Gulf of Boni, or from north to south instead of in the contrary direction as at first reported. From Palu, the valley of the Palu river, first penetrated by Messrs. Kruijt and Adriani in 1897, was ascended, and a visit paid to Lake Lindu, also reached by the explorers just mentioned. The lake is only about 5 miles long, but is very picturesque, and is bounded on the east by the high range of Ngilalaki. Its altitude is some 3250 feet, and its maximum depth was found to be 213 feet. Trouble with the natives necessitated an appeal to the Governor of Celebes, whose energetic action enabled the travellers to continue their journey after some delay. Crossing the watershed of the Palu river, they entered the basin of a much larger stream, the Koro, which astonished them by its size and depth at this distance from the sea. Only its mouth, near Lariang, has hitherto been known, though it appears to be the most important river of western Celebes. The route was a difficult one, passing through an almost uninhabited region, now high up above the river on the steep mountain-sides, now among the rocks in its bed. Crossing a range to the east, the travellers reached a peculiar plain 2600 feet above the sea, surrounded by mountains and having the appearance of being due to local subsidence, in which many earthquakes have been experienced within the last two years. The plain contains many villages. Hence the route ascended the wooded Topapu range to the open plateau of Leboni, some 3250 feet above the sea, where the thermometer sank as low as 52° Fahr. South of Leboni the mountains, which possessed a rich flora and an uncommon bird-fauna, increased in height, and on the fourth day a view was obtained of a high mountain in the east, named Koruve, which is considered to be the highest yet known in Celebes, being estimated at over 10,000 feet. The route finally led down into the valley of the Baliase and over a well-cultivated plain to the Gulf of Boni. Interesting collections were made in the departments of ethnology, zoology, botany, and geology, while positions were fixed astronomically and heights determined by boiling-point observations, the result being to considerably modify the map of west central Celebes.

AFRICA.

The Livingstone Memorial: Initials at Garden Island.—Writing from Zomba on December 17, Mr. Alfred Sharpe informed us of the completion of the monument which has been erected to the memory of Dr. Livingstone on the site of the great explorer's death, sending also a photograph of the monument, which we here reproduce. The work, Mr. Sharpe says, has been excellently carried out by Mr. Codrington, to whom much credit is due for his energy in the matter. It is considered very suitable for the situation, and is made of well-burnt bricks, thickly coated with cement; while there are no flat surfaces on which rain can lodge, so that it may be expected to last for many years. There will be a considerable balance from the sale of the cement not needed for the work, and this it is proposed to spend on the erection of a native hospital, to be known as the "Livingstone Memorial Hospital," at Fort Jameson, the nearest European settlement to the spot where the explorer breathed his last. A letter from Major Coryndon to the secretary of the British South Africa Company, describing a visit to Garden island by Mr. Sykes, District Commissioner at the Victoria falls, has also been courteously placed at our disposal. It may be remembered that when Garden island, which

lies in the centre of the river just above the falls, was first visited by Dr. Livingstone, the explorer, for the first and last time in Africa, cut his initials on a tree, adding the date 1855. During the second Zambezi expedition, Mr. Charles Livingstone added his initials, with the date 1860 and the Government broad arrow, below those of his brother; while Mr. W. C. Baldwin, who visited the spot while the Livingstone expedition was there, states that he also cut his initials on

LIVINGSTONE MEMORIAL.

the same tree. Garden island was visited soon afterwards by Baines, but in recent years no one appears to have been on the island until it was visited by Major Coryndon and Mr. G. Grey, who, however, failed to find the inscription, in spite of careful search. Mr. Sykes was guided to the spot by an old native, and found that the letters, though not very plain, were unmistakable. The bark is rough, and the date is now undecipherable.

The Condition and Prospects of Rhodesia.—During the latter part of 1902, Mr. J. F. Jones, joint manager and secretary of the British South Africa Company, made a journey through Rhodesia, in company with three of the directors, studying especially the commercial condition of the territory. His report, issued in February last, gives some useful information on the present position as regards the development of the resources of Rhodesia, of the value of which he has formed a high opinion. The country, he holds, is steadily recovering from the stagnation caused by the late war, and progress and prosperity, founded upon a sure basis, are now in sight. The facts put forward in the report seem certainly to justify a favourable view of the progress so far made and the possibilities for the future. The primary need of a new country, viz. easy means of communication, has been well supplied by the extensive railway system, either already existing or under construction, the mileage now amounting to 2193 miles, while so carefully have the needs of the country been considered in the location of the lines that on the completion of the various branch lines now projected every mine of importance now at work in Rhodesia will be within 20 miles of a railway. The principal extension now under construction is that from Bulawayo *viâ* the Wankie coalfield to the Victoria falls and the mining districts of the Kafue, which may eventually be continued through north-eastern Rhodesia to Lake Tanganyika.* Branch lines are also being made from Bulawayo to the Gwanda goldfields, and from Gwelo to the Selukwe district; while a line will also be made from Salisbury to the Mazoe district so soon as the survey is completed. The construction and equipment of the railways is said to be excellent, while their working, no less than that of the mines, will be enormously benefited by the existence of an inexhaustible supply of excellent coal, which is now assured. On the arrival of the line at the Wankie coalfield, probably in the present month, it is stated that a daily output of 300 tons will be at once available, and this may be increased, if necessary, to 1000 tons daily, the coal being equal to any, except the best Welsh, for steam purposes. Hitherto wood has been largely used, and in many parts the country has been cleared of timber, but planting is now being carried out to replace this. As regards the mineral wealth, it is expected that the output of gold will be doubled in a few years, while there are vast deposits of copper, lead, zinc, and iron in the Kafue region, those of the first three promising to rank among the richest in the world. The enormous water-power available at the Victoria falls will probably be utilized in course of time to generate electricity for conveyance to the mines. Lastly, as regards the agricultural resources, a large part of the surface consists of a rich red loam, capable of growing anything, and as the country is extremely well watered, irrigation has rarely to be resorted to in order that two crops may be reaped in the year. With the industrial development of the country, markets for produce of all kinds are extending.

Geodetic Work in South Africa.—In speaking of the Report for 1901 of the astronomer at the Cape (*Journal*, vol. xx. p. 453), we recorded the extension to the Zambezi during that year of the geodetic arc of the meridian now in course of measurement, and the approaching commencement of work north of the river. Arrangements for this have since been completed, and the direction of the work has been put into the hands of Dr. Rubin, of Upsala, who last year superintended the completion, by the Swedish party, of the measurement of the arc in Spitsbergen. Dr. Rubin was in this country, *en route* for South Africa, about the middle of March.

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* No reference is made to the proposed northern line into the Congo State, about which a good deal was said last year in the daily press.

Railways and Boundaries in West Africa.—Among the many recent schemes for railways in the West African colonies and protectorates, one of the latest set on foot is that for a line from Thies, a point on the Dakar-St. Louis railway, in the French colony of Senegal, to Kayes, the starting-point of the railway to the upper Niger, which has been under construction for so many years. According to a note in the *Mouvement Géographique* for February 15, a survey of a line of route for this railway, which it is proposed to carry through the Jolof country, Bondu, and Bambuk, is about to be commenced. It is not thought that the ground will cause many difficulties, though want of water over a part of the route may make itself felt. Serious steps have also been taken in Germany towards the construction of a railway from the coast into the Kamerun hinterland, to be carried ultimately, it is hoped, to Lake Chad. A syndicate, formed in Berlin, last year despatched an expedition under Herr Robert Neumann for the survey of various suggested lines of route, and it has lately returned after completing its labours. We learn from the *Geographische Zeitschrift* (1902, No. 11), that one of the suggested lines starts from Victoria, and runs by Mundame to Tinto and Bali; another makes the capital, Duala, its starting-point, but from Mundame onwards coincides with the first; and a third strikes inland from Duala by a more southerly route, to Yabassi and Tibati. From the *Deutsches Kolonialblatt* for March 1, we gather some details respecting the survey, now in progress, of the boundary between the Kamerun and French Congo. The German members of the commission, Captain Engelhardt and Lieut. Förster, had separated last October at the Ngoko station, the former proceeding in steamers up the Sanga and Kadei, with a view to continuing up the latter in canoes, and making his way overland to Bertua; the latter proposing to follow the Sanga to Bania, and then march to the coast by way of Gaza and Kunde, determining the positions of these three places, on which the line of the boundary will in great measure depend. For the demarcation of the northern Kamerun boundary with Nigeria, a joint expedition set out in January, the British commissioner being Colonel L. C. Jackson, R.E., the German, Captain Glauning, who has already done much good work in East Africa. The boundaries between Nigeria and the French Sahara, and between the Gold Coast and Liberia will also be demarcated during the present season.

A Survey of Lake Chad.—We learn from the *Politique Coloniale* of March 4, that a careful survey of Kanem and Lake Chad has been carried out by Lieut.-Colonel Destenave and the officers under his orders, and that the results have been received by the Paris Academy of Sciences. The whole of the French portion of the lake is said to have been minutely surveyed, so that its contours will now for the first time be known with any accuracy.

AMERICA.

Mount McKinley, Alaska.—Reference has been made in the *Journal* to the expedition to the region of Mount McKinley, the highest known point of North America, carried out last summer by Mr. A. H. Brooks, of the United States Geological Survey. The official report on the journey is still in preparation, but Mr. Brooks gives, in association with Mr. D. L. Raeburn, who also took part in the expedition, some notes on the mountain and its neighbourhood while discussing plans for its ascent in the January number of the *National Geographic Magazine*. The Alaskan range, in which Mount McKinley occurs, is a rugged mountain mass running north-east from the vicinity of Lake Clark, and forming the watershed between the Sushitna river and Cook inlet on the south-east, and the Kuskokwim and Tanana on the north-west. On the east and south it rises by a series of foothills from the Sushitna, and on the west it falls abruptly to a gravel-floored plateau,

which slopes gradually towards the Kuskokwim. In addition to Mount McKinley, over 20,000 feet in height, it contains Mount Foraker, 14 miles to the south-west, about 17,000 feet, as well as a number of peaks of from 10,000 to 14,000 feet in the north-east. McKinley, which lies in about the centre of the length of the range, but much nearer the western than the eastern margin, is dome-shaped, and has two summits 2 miles apart, the southernmost being the higher by some 1000 feet. The north-western slope is drained by a large glacier, which discharges into a tributary of the Toklat (basin of the Tanana). An expedition for the purpose of climbing the mountain should approach from this side, both because the peak lies towards that side of the range, and because the gravelly plateau above alluded to is for the most part above timber (the upper limit of spruce is about 2500 feet, though willow sufficient for fuel is found up to 4000), and affords ready access to the base of the mountains where good grass is plentiful. The snow-line is at about 7000 feet instead of at sea-level as in the case of Mount St. Elias, and the writers consider that the actual ascent would present no exceptional difficulties, the long and difficult journey to the base being a more serious matter. Alternative plans for a summer expedition are (1) to cross overland from Cook inlet to the Kuskokwim headwaters, and then follow the base of the range north-east; (2) to proceed by Dawson and the Yukon to the mouth of the Tanana, ascending that river and its tributary, the Toklat, as far as possible. But in order to reserve the strength of the party for the actual ascent, the writers favour the idea of wintering in the region, and transporting the supplies to the base of the mountain during the winter and spring by the help of dogs.

AUSTRALASIA AND PACIFIC ISLANDS.

Memorial to Captain Collett Barker in South Australia.—Captain Collett Barker, of the old 39th (Dorset) Regiment, went out with that regiment to Australia in 1825, and though his career was brought to a tragic close only six years later, had during that interval given proofs of energy and determination which promised much for his future achievements as a pioneer in that then virgin country. As it was, he did some valuable work in this direction, which has lately been fittingly commemorated by the erection of a monument at the township of Mount Barker, near the scene of his untimely death. The *Adelaide Observer* of January 24 contains an account of the ceremony at the unveiling of the memorial, giving also a short account of the journey which proved fatal to the explorer. It was undertaken in 1830, during a voyage from King George's sound to Sydney, with a view to completing the exploration of the neighbourhood of the mouth of the Murray lately carried out by Sturt, who was an officer in the same regiment. Landing on the east shore of St. Vincent gulf, Captain Barker proceeded inland to Mount Lofty, discovering the second high peak in this neighbourhood which now bears his name, and thence went to the mouth of the Murray to ascertain whether it had any other outlet than that discovered by Sturt. He swam across the river alone, and was never afterwards seen by his companions, who, however, obtained almost certain proof that he had been murdered by natives. The monument, an illustration of which is given in the *Observer* for January 31, is an obelisk of polished Carrara marble, mounted on a base of rough-hewn granite.

Surveys and Forestry in New Zealand.—In the report of the Department of Lands and Survey, New Zealand, for 1901-02, Mr. Marchant, the Surveyor-General, refers to the question of a national survey, to be executed in accordance with the best modern geodetic methods, the importance of which has frequently been urged in the colony. He points out that New Zealand is wealthy and prosperous; that the greatest facilities are afforded for communication, while former

tedious and expensive processes have been superseded and instruments made more portable; and that there are capable and energetic officers eager to undertake the work. He therefore suggests that the time has come for at least making a beginning with such a survey, which would be valuable as contributing data for the determination of the exact figure of the Earth. Some account is also given of the progress hitherto made with the magnetic survey of the colony, begun in 1899. During the last year the survey has been in abeyance, as the attention of Dr. Farr and his assistant has been devoted solely to observatory work, but the importance of a resumption of field work is strongly urged. Dr. Farr describes the newly erected observatory and the work done in it, as well as the arrangements for co-operation with the British Antarctic Expedition as regards magnetic work. A memorandum is also given on the longitude of the Mount Cook Initial Station, Te Aro, Wellington, the point to which the New Zealand surveys are referred. A full statement is given of the steps which have been taken at various times to determine this and other longitudes in New Zealand, and it is shown that, by the recent telegraphic determinations of the longitude of Sydney observatory, and of the difference between that observatory and Mount Cook, a correction of $-0{\cdot}4^s$ on the value, $11^h\ 39^m\ 9{\cdot}22^s$, hitherto used for Mount Cook Initial Station, is found to be necessary. The report on Forestry operations states that the total area of artificial plantations is 853¾ acres, and the total number of trees in the nurseries 5,982,710, valued at over £10,000. A comprehensive scheme for forest conservation and planting is said to be in course of preparation, the general cry being once more repeated that the native forests are being rapidly denuded, and that protection and provisions for the future are matters of urgent necessity.

POLAR REGIONS.

Relief Expedition for Baron Toll.—A relief expedition, consisting of six sledges drawn by dogs, has started from Eastern Siberia to New Siberia, under the command of the engineer Brusneff, for the relief of Baron Toll. Moreover, Lieut. A. V. Kolchak, recently returned from the New Siberia expedition, must have also left Siberia by this time with the same object. His expedition, consisting also of a number of sledges drawn by dogs, will proceed to New Siberia *viâ* Ust-Yansk and Kazachiye. If Lieut. Kolchak does not meet Baron Toll in New Siberia, he will march, on the ice, to Bennett Land, it being known that Baron Toll, when he left the *Zarya* on July 6 last in the Nerpichiya bay of Kotenyi island, intended to proceed *viâ* Faddéeff island and Cape Wussokyi to reach, on the ice, Bennett Land, and there to carry on scientific work. He was accompanied by the astronomer, F. G. Seeberg and two Yakutes. He had two *baidaras* (boats) for crossing the open spaces amidst the ice, and it is supposed that he may winter on Bennett island. The zoologist Birula, who was at first reported to be likewise cut off from return to the mainland, has, it appears, safely reached Irkhutsk, having left New Siberia on December 4. He states that Baron Toll reached Cape Wussokyi on July 10, and after depositing a record stating that his party was well, started again for Bennett Land.

Arctic Expeditions in 1903.—Undaunted by his previous unsuccess in his endeavour to reach the pole, Commander Peary is already planning a new expedition, which, he says, he will proceed to organize so soon as he can secure the necessary funds. He is said to be searching for a suitable vessel for his purpose. The expedition to be despatched this year by Mr. Baldwin by way of Franz Josef Land will make a final start from Tromsöe, for which port the *America*, commanded by Captain Coffin, sailed from New York about the middle of March. The leader of the expedition, Mr. Anthony Fiala, has reached England *en route* for Tromsöe, but will, it is said, return to America to collect his scientific staff before finally sailing.

German Auxiliary Expedition to the Antarctic.—The example set in this country by the despatch of the *Morning* to the antarctic is to be followed, it appears, in Germany, where a movement is on foot for the despatch of a relief expedition during the present year, in case no news of the main expedition should be received by June 1. According to *Petermanns Mitteilungen* (No. 1, 1903), a sum of £24,250 has been placed on the estimates for the current year for the fitting out of such an expedition.

GENERAL.

Geography at British Universities.—The first number of the *Geographical Teacher* for the current year summarizes in a useful way the present state of geographical teaching at the British Universities, the various arrangements as to lectures, courses of study, examinations, etc., in force at each being fully stated. While the list brings out the regrettable deficiency which still exists as regards chairs in geography, the much-needed endowment of which would enable a certain number of men to devote their whole energies to the study and teaching of geography, and so do more than anything else to obtain recognition for the subject as an independent branch of education, there is much which goes to show that progress is being made all over the country with the organization of geographical teaching, and presents on the whole an encouraging picture as compared with the state of things fifteen or twenty years ago. By continued exertion, we may hope that before very long still more decided results will be obtained.

Geography in the University of Chicago.—The University of Chicago has established a Department of Geography, and Prof. Rollin D. Salisbury, of the Department of Geology, has been placed at its head. The arrangement between the Departments of Geology and Geography is such that Prof. Salisbury retains his connection with the former, as heretofore, at the same time that he assumes the headship of the latter. The close connection of the two departments appears from the fact that Prof. Salisbury will also act as head of the Department of Geology when Prof. Chamberlin is not in residence, and Prof. Chamberlin will act as head of the Department of Geography in Prof. Salisbury's absence. The Department of Geology has heretofore offered courses, both elementary and advanced, in Physical Geography, and elementary courses in Meteorology. Other courses of a geographic character have been offered by other departments, notably Geographic Botany by the Department of Botany, Zcögeography by the Department of Zcölogy, and Commercial Geography by the Department of Political Economy. These courses will continue to be given as heretofore by these several departments, except that Meteorology will be under the auspices of the new department. The new department will not duplicate the geographic courses already given, but will, at the outset, provide courses which supplement those already established. The immediate aim of the new department will be to occupy the ground intermediate between Geology and Climatology on the one hand, and History, Sociology, Political Economy, and Biology on the other. The courses offered at the outset will be those for which, within this field, there is greatest demand. John Paul Goode, PH.D., in charge of the work of Geography in the Wharton School in the University of Pennsylvania, has accepted an assistant professorship in the Department of Geography, and will begin his work the second term of the Summer Quarter (July 27, 1903). No other appointment will be made this year. During his first year, Dr. Goode will be in residence during the second term of the Summer Quarter, and during the Autumn and Spring Quarters. The courses which he will give during the first year will include courses on the Economic Geography of (1) North America, (2) Europe, and (3) Tropical Countries. The central theme of these courses will be the influence of the physiography, the climate, and the

natural resources of these lands on their settlement, development, and present commercial and industrial status. Research courses will also be offered for advanced students. The geographic work of the university during the coming year will include the following courses, in addition to those given in the Department of Geography:—I. In the *Department of Geology*— (1) An elementary course in Physiography each quarter; (2) A local field and laboratory course, first term Summer Quarter; (3) Two field courses in Geology and Geography about Devil's Lake and the Dells of the Wisconsin, in Wisconsin, one month each, commencing June 18 and July 27 respectively; (4) A course in advanced Physiography, Autumn Quarter; (5) A field course (for advanced students) in the Wasatch mountains of Utah and vicinity. Other courses which, while primarily geological, are fundamental to the proper conception of the evolution of the present geography of the continents, will also be given in this department. II. In the *Department of Zoölogy*—Courses in Zoögeography, Summer and Spring Quarters. III. In the *Department of Botany*—(1) An elementary course in Plant Geography (time not announced); (2) An elementary course in Ecology, Summer and Spring Quarters: (3) Elementary and advanced courses in Field Botany, Summer and Spring Quarters; (4) Advanced courses in Geographic Botany, Winter Quarter; and (5) A course in Physiographic Ecology, Summer and Spring Quarters. IV. In the *Department of Political Economy*—Courses in Commercial Geography, Summer, Autumn, and Winter Quarters. In addition to the foregoing, courses in Geography will be given by Miss Baber in the School of Education (the Normal Department of the University). These courses are planned primarily with reference to the needs of teachers in the grades. Miss Baber will also conduct a field course of one month's duration during the second term of the Summer Quarter, beginning July 27.

International Geological Congress, 1903.—We have received further details of the programme of the International Geological Congress to be held in Vienna in August next (see *Geographical Journal*, December, 1902, p. 660). There will be discussions on the "overfolded" or "overthrust" sheets ("verschobenen Tafeln," "nappes de charriage," "lambeaux de recouvrement"), which play such an important part in the structure of the mountains of Scotland, the Jura, and the Alps; and on "Klippen." In these, Messrs. V. Uhlig, M. Lugeon, F. Toernebohm, Bailey Willis, and F. Kossmat are expected to take part. A special sitting will be devoted to questions concerning the geology of "The Balkan Peninsula and the East," when papers will be read by Messrs. F. Toula, V. Hilber, J. Cvijić, G. von Bukowski, F. Katzer, and A. Philippson. Mr. F. X. Schaffer will contribute a paper on the soil (*Boden*) of the town of Vienna. The extensive engineering works carried out in the city and neighbourhood during the last ten years have exposed many deposits which have led to important discoveries by Prof. Suess. The paper will be illustrated by a large geological map on a scale of 1 : 10,000, and numerous sections.

OBITUARY.

William Henry Crosse.

William Henry Crosse, M.D., F.R.G.S., died in London on February 24, at the comparatively early age of forty-four, through illness resulting from his residence in Africa. He was probably best known to Fellows of the Society generally by the Medical Hints published in the 'Hints to Travellers.' This chapter (VII.), elaborated by Dr. Crosse with characteristic care, is of special value to residents

and travellers in tropical countries, owing to Dr. Crosse's long personal experience of Equatorial Africa and his subsequent practice in London as a consulting physician in cases connected with tropical diseases.

He was the son of the present Vicar of Terrington St. Clement. He was born at Lucan, Dublin, and educated at St. John's Foundation School, Leatherhead. At the age of seventeen he entered Guy's Hospital. After leaving the hospital, a small practice in Cubitt Town was bought by him. Such was his skill and energy that in five years his income rose from £300 to about £1500, a fine result for a young man who was too modest and retiring to be an adept in the art of self-advertisement. Illness, through overwork, compelled him to relinquish his practice; but after voyages to China and other parts of the world, he recovered his health.

At that time (1886) the Royal Niger Company had just received its charter, and was seeking for an able and energetic head of its medical staff. This post his exceptional testimonials secured for him, and he passed most of the following nine years in what is now known as Southern Nigeria. He paid two or three brief visits to England, and travelled extensively in Northern Nigeria when his duties required it; but, as principal medical officer, his official residence was at Asaba, the seat of the company's civil administration. There he was able to employ his scanty leisure in the interesting study of the pagan tribes of that region, and in compiling more than one useful treatise on malarial fever and other tropical diseases. His surgical skill was also of great value, as there was scarcely one of the company's numerous military expeditions, from 1886 to 1895, in Southern Nigeria in which he did not take part. These were to him the most interesting years of his life. Although, after his return to London in 1895, he gradually built up a good practice, he more than once contemplated a return to Nigeria, where his sympathetic nature and his unwearying care for his patients will be remembered with affection and regret by all who knew him.

Dr. Crosse was also much interested in natural history, and made collections whenever the chance was offered, insects being his particular favourites. The first series from his collections was presented by him to the British Museum, and the second set he gave to the Hope Museum at Oxford. One of the most beautiful of West African butterflies has been named after him, *Euphædra crossei*, by Miss E. M. Bowdler-Sharpe.

GEORGE TAUBMAN GOLDIE.

Prof. Poulton has kindly sent the following notes:—

The few hundred insects presented by Dr. W. H. Crosse to the Hope Museum range over many orders, the Coleoptera and Rhynchota Hemiptera being the most numerous. Although it is improbable that there are many rare species, the whole collection forms an interesting assemblage eminently characteristic of the West African sub-region. The relative predominance of mimetic associations among the Ethiopian Lepidoptera Rhopalocera is well shown. In a series of under 90 specimens the following interesting examples occur: three specimens of *alcippus*, the white hind-winged form of *Limnas chrysippus*, with *Hypolimnas misippus*, both male and female. The latter is the type form mimetic of the type form of *chrysippus*, which does not occur in this part of Africa. Of the genus *Amauris*, only *A. egialea* appears in the collection (three specimens), although examples of *Papilio merope* are present, three of them females of the form which is a beautiful mimic of *Amauris niavius*. A single specimen of *Euralia dubius* is of the form with a reduced white patch at the base of the hind wing, a mimic of *Amauris hecate* and certain varieties of *A. psyttalea* (= *damocles*, *enceladus*). There is also a specimen

of *Neptis agatha* and the convergent *Neptidopsis ophione*. *Acræa lycoa*, of which there are two specimens, has probably approached the black and white species of *Amauris*, such as *egialea* and *psyttalea*. The pale green spotted *Papilio leonidas* is represented by a single example, although its mimic, *Tirumala petiverana*, is absent. The important synaposematic group of large black and red *Acraeinæ* is represented by *A. pharsalus* (1 ♂, 2 ♀), and *A. zetes* (2 ♂). But it is in the *Pierinæ* that the predominance of mimetic resemblance is most obvious. Out of twenty-six specimens, no less than ten, of various genera and species, exhibit the black marginal spots, which are probably in all cases to be traced to the influence of the dominant distasteful genus *Mylothris*.

The series of Rhynchota Hemiptera contain several large conspicuously coloured species of *Reduviidæ*, and convergent colours and patterns are obvious within the order, as well as between it and the Lycid Coleoptera. The chief representatives of the latter order are many fine and characteristic West African species of Longicornia, Cetoniidæ, and Heteromera.

The chief interest of the collection is probably the evidence that it supplies of the relative importance of bionomic principles, and especially Müllerian mimicry, as determining factors in the evolution of colour and marking.

Dr. Karl Ritter von Scherzer.

The Society has recently lost one of its most distinguished honorary corresponding members in the person of Dr. Karl von Scherzer, best known to geographers as the head of the scientific staff of the *Novara* during the voyage round the world in 1857–59, though his work in this connection, valuable as it was from a scientific point of view, formed but a small part of his restless and many-sided activity. The following brief sketch of his life is mainly based on a biographical notice, issued little more than a year ago in Vienna, as the first instalment of a "Gallerie denkwürdiger Personen der k. k. Hof- und Staatsdruckerei," in which establishment Dr. Scherzer commenced his career.

Scherzer's ancestors were formerly settled at Eger in Bohemia, but in Reformation times were, as Protestants, forced to leave their fatherland, moving from one place to another, until in 1796 the father of our late associate, then twenty years old, took up his abode in Vienna. His son Karl was born in 1821, and in 1834 entered the Government printing-office as an operative. Although his connection with this establishment ceased three years later, he remained more or less in touch with the printing and publishing trade for some years, during which he completed his education by extensive foreign travel. In 1848 he championed the cause of the Vienna printers, and it was through his energetic advocacy that a revision of the scale of charges and other advantages were secured by the trade in that year. For his attitude on this and other questions he was regarded with suspicion by the authorities, and was twice brought before a court-martial to answer for his conduct. It was about this time that he formed the acquaintance with Dr. Moritz Wagner, which turned his thoughts in the direction of more extended travel. The two friends sailed for New York in 1852, and spent the next few years in researches—political, economical, and scientific—in the United States, Canada, and the Central American republics. In the last named, then very imperfectly known in Europe, results of great value in regard to the geography, natural history, and ethnology of the several states were obtained, and, among other studies, the ruins of Quirigua were visited, and collections made on behalf of the British Museum. In 1855 and 1856 Scherzer devoted himself to the working up of his material, besides contributing largely on more general subjects to the *Allgemeine Zeitung* of Augsburg

and to Peschel's *Ausland*. His writings brought him to the notice of the Finance Minister, who introduced him to the Archduke Ferdinand Maximilian, the result being his appointment, in November, 1856, to the scientific commission of the *Novara*, then being fitted out for the famous voyage, which lasted from April, 1857, to November, 1859. Before starting, Scherzer took great pains to qualify himself for his task by correspondence with Darwin, Lyell, Murchison, Haeckel, and other scientific men, and the results obtained were, as is well known, of very great value, not only from the scientific point of view, but from that of commerce and statistics, which fell within Scherzer's more particular sphere.

Scherzer's services were secured, in 1866, for the Austrian Ministry of Commerce, with which he remained connected, in one capacity or another, until his retirement in 1897, the value of his work being repeatedly recognized by decorations and other honourable distinctions. Before representing his country as consul in many important centres, including Smyrna, London, Leipzig, and Genoa, he took part in another important voyage, that of the *Donau* and *Friedrich*, despatched to the Far East in 1868 mainly for political and commercial objects. Scherzer made a special study of the Suez canal, then under construction, and, after visiting the chief centres of Indo-China, China, and Japan, crossed the Pacific and prosecuted his mission in California, Central America, Peru, and Chili, subsequently embodying the material collected in valuable reports and memoirs. His last important work, entitled "Das Wirtschaftliche Leben der Völker," was published at Leipzig in 1886. After his retirement from active work, he resided principally at Görz, and was latterly engaged in writing his varied reminiscences.

Dr. Josef Chavanne.

The well-known Austrian traveller and geographer, Dr. Josef Chavanne, died in December last at Buenos Aires, after an illness of some months. Dr. Chavanne was of Walloon extraction, and was born at Graz in 1846. His taste for geography and travel was first gratified in 1867, when he undertook an extensive journey through the Western States of the American Union, Central America, and the West Indies, ending up with a visit to Morocco and the Northern Sahara, then very much less known than they are now. The work in which he, some years later, embodied the results of his African researches, entitled 'Die Sahara, oder von Oase zu Oase' (Vienna, 1879), was at the time a contribution of some importance to our knowledge of Northern Africa. A few years later, in 1889, he undertook a journey to the Congo, the results of which he published under the title 'Reisen und Forschungen im alten und neuen Kongostaate' (Jena, 1887). A large part of his reputation as a geographer was, however, the outcome of scientific work at home. He resided for some years in Vienna, and for a time edited the *Mitteilungen* of the Geographical Society in that city. He published a Physical and Statistical Atlas of Austria-Hungary, and physical and other maps of the parts of the world of which he had made a special study. During the latter years of his life he devoted himself especially to the geography of Argentina, where he had held an appointment in the Hydrographical Office since 1895. Before this date he had done an important work in preparing, for the State Railway Administration, a map of the whole country on the scale of 1 : 1,000,000, on which, as well as the railways, the surface features of the country were carefully laid down. He also published a work on the climatology of Argentina, and for some time before his death had been engaged on an important study on the Andes.

CORRESPONDENCE.

The Geographical Training of Army Officers in the Universities.

At the present moment, when schemes for the more efficient training of officers are discussed on every hand, it may not be amiss for a geographer to outline, in the briefest way, his conception of how geography should be utilized in the training of an officer for the army.

That the officer on active service has to fight in a *real* world is, of course, obvious. The distribution of his troops depends, not merely on the distribution of the opposing troops, but also on the character of the region in which he finds himself—that is, on the distribution of surface relief, of water, of vegetation, and of routes. In the wider planning of a campaign, the general configuration, climatic and economic conditions of the region have also to be considered—that is to say, the geographical conditions as a whole. The importance of a single one of these conditions—topography, is partially realized, but the significance of the geographical factor as a whole is almost invariably overlooked. For lack of such instruction our officers are forced to acquire this knowledge by the most expensive of all methods, the empirical one of muddling out right in the end. This costly policy, with its concomitant waste of money and life, might be in a measure avoided if our future officers received a more scientific training in geography.

For a successful training in geography at a university, it is essential, in the first place, that the university military cadet should possess a sound preliminary knowledge of the subject before beginning his university course, and this must of course be acquired at school, unless the time at the university is to be wasted on teaching the veriest rudiments of the subject. This school work should include practical as well as book work, and a certificate should be required stating that the candidate has spent a minimum number of hours in practical work, in the field and in the school. The habit of observing the character of the surrounding country cannot be begun too early, and this, together with the power to read and construct an ordinary map, and a knowledge of the outlines of general geography, should be the necessary preliminary to any university study. There is no need to organize new machinery for the purpose. The syllabuses of the Senior Local, Joint University, and Leaving Certificate examinations need only be improved, and have this condition of practical school work attached as a preliminary to examination.

In the university course the geographical teaching might with advantage be specialized along three lines—regional, historical, and cartographical.

(1) The geographical course proper would include—(*a*) a general course dealing with the natural regions of the world, with special reference to the distribution of relief, rivers, routes, and strategic centres, and the ensemble of conditions forming what may be called the configuration control; (*b*) the sum of conditions forming the climatic control, with special reference to such phenomena as the incidence of seasons, frost periods, seasonal rains, winds, floods, etc.; and (c) with the sum of factors forming the economic control. In addition to this general course, army candidates should be expected to show a detailed knowledge of the characteristics of the topography of typical land-forms, and of all the geographical conditions of a prescribed region, and this should be completed by a ten or fifteen days' excursion through the regions in question. Naturally the parts of the British Isles and the nearer portions of the Continent would be chosen for this purpose.

(2) In the historical course, which exhibits the effect of geographical conditions on military movements in the past, the same order would be pursued—a general course dealing with the broad outlines of the historical military geography of Europe would be followed by the detailed study of a prescribed campaign, as,

for example, one of the campaigns of Napoleon, the American civil war, the Franco-German war, the Russo-Turkish war, or the Boer war.

(3) The cartographical course would deal with the construction of topographical maps, the use of common surveying instruments, and practice in (*a*) mapping natural features, (*b*) range-finding, and (*c*) the elements of position-finding. In the case of engineers, geodetic surveying would be added.

In order to interfere as little as possible with other university work, the courses should be spread over three academic years. During the first, the outlines of geography and military topography might be studied; during the second, the outlines of historical military geography and typical land-forms; and during the third, the detailed geography of selected regions and campaigns. For the future engineer, who would have to make as well as to use maps, advanced courses in surveying and geodesy would be necessary.

In such university courses the object should be to make the cadets familiar with the general principles and facts of geography, with the sources of information, with the many notations in which geographical data are recorded, and as far as possible with half a dozen typical districts, each having different topographical characteristics.

Summary.

- Geographical
  - A. Outlines of geography
    - (*a*) Configuration and routes.
    - (*b*) Climatic.
    - (*c*) Economic.
  - B. Detailed topography of typical land-forms.
  - C. Detailed geography of a typical region.
- Historical
  - A. Outlines of historical military geography.
  - B. Detailed history of a prescribed campaign.
- Cartographical
  - A. Accumulation and recording of data. Surveying and map-making.
  - B. Interpretation of data. Map-reading.

A. J. HERBERTSON.

MEETINGS OF THE ROYAL GEOGRAPHICAL SOCIETY, SESSION 1902-1903.

Eighth Ordinary Meeting, February 23, 1903.—Sir CLEMENTS MARKHAM, K.C.B., F.R.S., President, in the Chair.

ELECTIONS:—*Edwyn Barclay; G. Beach Chester; Athol Chichester; Robert James D'Arcy-Irvine; Emil Ernst; Marcus John Eustace, M.D., D.Ph.; John Foster Fraser; Guy John Fenton Knowles, C.E.; Captain C. H. Ley, R.E.; William Cameron Mackay; Charles Godfrey Moule; Henry Francis Previté, M.A.; Colin Skittal Reddie; Captain Cecil B. Simonds, R.G.A.*

The Paper read was:—

"Further Explorations in the Canadian Rockies." By Prof. Norman Collie, F.R.S.

Ninth Ordinary Meeting, March 9, 1903.—Sir CLEMENTS MARKHAM, K.C.B., F.R.S., President, in the Chair.

ELECTIONS:—*William Sloane Accles; Captain Lionel Edmund Anstey-Bennett (Paget's Horse); Lieut.-Colonel T. Capper (East Lancashire Regiment); Captain Henry E. M. Douglas, R.A.M.C., V.C., D.S.O.; Fergus Dwyer; Albert Edward*

Evans, R.N.R.; George William Poole Fisher; Thomas George Goodman; Lieut.-Colonel H. P. Gough, 16th Lancers; Arthur Hall Hall; James Meldrum; Major P. R. Phibbs (Dorset Regiment); Thomas George Seymour; Everard D. Simpson, B.A.; Captain W. M. Guthrie Smith, I.S.C.; Hugh Rose Troup; Rev. W. W. Tyler, B.D.; Thomas Herbert Worsnop.

The Paper read was :—

"A Buried Landscape in the English Midlands." By Prof. W. W. Watts.

GEOGRAPHICAL LITERATURE OF THE MONTH.

Additions to the Library.

By EDWARD HEAWOOD, M.A., *Librarian*, R.G.S.

The following abbreviations of nouns and the adjectives derived from them are employed to indicate the source of articles from other publications. Geographical names are in each case written in full :—

A. = Academy, Academie, Akademie.
Abh. = Abhandlungen.
Ann. = Annals, Annales, Annalen.
B. = Bulletin, Bollettino, Boletim.
Com. = Commerce.
C. Rd. = Comptes Rendus.
Erdk. = Erdkunde.
G. = Geography, Geographie, Geografia.
Ges. = Gesellschaft.
I. = Institute, Institution.
Iz. = Izvestiya.
J. = Journal.
k. u. k. = kaiserlich und königlich.
M. = Mitteilungen.
Mag. = Magazine.
Mem. = Memoirs, Mémoires.
Met. = Meteorological.
P. = Proceedings.
R. = Royal.
Rev. = Review, Revue.
S. = Society, Société, Selskab.
Sitzb. = Sitzungsbericht.
T. = Transactions.
V. = Verein.
Verh. = Verhandlungen.
W. = Wissenschaft, and compounds.
Z. = Zeitschrift.
Zap. = Zapiski.

On account of the ambiguity of the words *octavo*, *quarto*, etc., the size of books in the list below is denoted by the length and breadth of the cover in inches to the nearest half-inch. The size of the *Journal* is 10 × 6½.

A selection of the works in this list will be noticed elsewhere in the "Journal."

EUROPE.

Alps. *Globus* **83** (1903): 21–23. **Halbfass.**

Beiträge zur Kenntnis der Seen der Lechthaler Alpen. Von W. Halbfass. *With Maps.*

Ardennes. *Deutsch. Rundschau G.* **25** (1902–1903): 102–110, 165–172, 212–220. **Kellen.**

Durch die Wälder der Ardennen. Von Tony Kellen. *With Illustrations.*

Austria—Moors. *Deutsch. Rundschau G.* **25** (1903): 193–207. **Bersch.**

Die Moorgebiete Österreichs. Von Dr. W. Bersch. *With Map and Illustrations.*

Belgium—Historical. **Huisman.**

La Belgique Commerciale sous l'Empereur Charles VI., la Compagnie d'Ostende. Etude historique de politique commerciale et coloniale. Par Michel Huisman. Bruxelles: H. Lamertin, 1902. Size 9½ × 6½, pp. xii. and 556.

Denmark. ——

Den Danske Turistforenings Aarsskrift, 1903. København: G. E. C. Gad, 1903. Size 9½ × 6, pp. 72 and xxxiv. *Map and Illustrations. Presented by Mr. E. L. Salomonsen.*

Europe—Maps and Views. — ——

Topographie de l'Europe. Catalogue à prix marqués de Cartes anciennes et de Vues de Villes, XV^me^–XIX^me^ siècle. Amsterdam: F. Muller & Cie., 1903. Size 9½ × 6½, pp. 240.

France—Corsica—Malaria. *Questions Dipl. et Colon.* **15** (1903): 157–166. **Guasco.**
Le paludisme et l'initiative privée en Corse. Par A. Guasco.

France—Glaciers. *C. Rd.* **136** (1903): 107-109. **Girardin.**
Sur des observations glaciaires faites en haute Maurienne dans l'été de 1902. Note de Paul Girardin.

France—Provence. *B.S.G. Marseille* **26** (1902): 260–272. **Barré.**
La répartition de la population sur le Sol de la Provence. Par H. Barré.

France—Rhone. *Ann. G.* **11** (1902): 407–418. **Douxami.**
La vallée moyenne du Rhône à travers le Jura méridional. Par H. Douxami.

France—Rochefort. *B.S.G. Rochefort* **24** (1902): 281–301. **Roche.**
Le Port de commerce de Rochefort. Par F. Roche. *With Map and Plan.*

Germany. **Bludau.**
Oberland, Ermeland, Natangen und Barten. Eine Landes- und Volkskunde von Prof. Dr. Alois Bludau. Stuttgart: Hobbing & Büchle, 1901. Size 8½ × 6, pp. xii. and 340. *Map and Illustrations. Price* 9 *m. Presented by the Publishers.*

Germany. **Volk.**
Der Odenwald und seine Nachbargebiete. Eine Landes- und Volkskunde. Unter Mitwirkung vieler Landeskenner herausgegeben von Georg Volk. Stuttgart: Hobbing & Büchle, 1900. Size 8½ × 6, pp. 440. *Map and Illustrations. Price* 10 *m. Presented by the Publishers.*

Germany—Bavaria. **Hübler.**
Bayerisch Schwaben und Neuburg, und seine Nachbargebiete. Eine Landes- und Volkskunde von Dr. J. M. Hübler. Stuttgart: Hobbing & Büchle, 1901. Size 8½ × 6, pp. viii. and 326. *Map and Illustrations. Price* 7 *m. Presented by the Publishers.*

Germany—Bavaria. *Vierteljahrs. G. Unterricht* **2** (1903): 90–93. **Kollbach.**
Ein Ausflug in die Hohe Rhön. Von K. Kollbach.

Germany—Prussia—Westphalia. **Hellmann.**
Regenkarte der Provinz Westfalen sowie von Waldeck, Schaumburg-Lippe, Lippe-Detmold und dem Kreis Rinteln. Mit erläuterndem Text und Tabellen. In amtlichem Auftrage bearbeitet von Prof. Dr. G. Hellmann. Berlin: D. Reimer, 1903. Size 10½ × 7, pp. 30. *Map.*

Germany—Rhine. *Meteorolog. Z.* **19** (1902): 548–551. **Stolberg.**
Verhalten der Rheintemperaturen in den Jahren 1895–1900. Von A. Stolberg.

Germany—Thuringia. *Z. Ges. Erdk. Berlin* (1902): 850–874. **Schlüter.**
Die Siedelungen im nordöstlichen Thüringen. Von Dr. Otto Schlüter.

Greece—Eubœa. *C. Rd.* **136** (1903): 105–107. **Deprat.**
Note préliminaire sur la géologie de l'île d'Eubée. Note de M. Deprat.

Holland. *Tijds. K. Ned. Aard. Genoots. Amsterdam* **20** (1903): 1–34. **Bruijn.**
De temperatuur van de onderaardsche gangen in den St. Pietersberg en andere mergelgroeven bij Maastricht. Door Fred. de Bruijn, S.J. *With Maps.*
To be noticed in the Monthly Record.

Italy. **Baedeker.**
Italy. Handbook for Travellers, by Karl Baedeker. Third Part: Southern Italy and Sicily, with Excursions to the Lipari Islands, Malta, Sardinia, Tunis, and Corfu. Fourteenth Revised Edition. Leipsic: K. Baedeker, 1903. Size 6½ × 4, pp. lii. and 444. *Maps and Plans. Price* 6 *m. Presented by the Editor.*

Italy. **Nissen.**
Italische Landeskunde. Von Heinrich Nissen. Zweiter Band. Die Staedte, Zweite Haelfte. Berlin: Weidmannsche Buchhandlung, 1902. Size 9 × 6, pp. 481–1004.
Cf. *Journal*, vol. xx. p. 351.

Italy—Emilia. *Rev. G. Italiana* **9** (1902): 437–445, 499–506, 565–581. **Lorenzi.**
Intorno ad alcune salse del Modenese, osservazioni del Dott. Arrigo Lorenzi.

Mediterranean—Crete. *J.R.I. Brit. Architects* **10** (1902): 97–106. **Evans.**
A Bird's-eye View of the Minoan Palace of Knossos, Crete. By Dr. A. J. Evans. *With Plan and Illustration.*

Norway—Railways. *Globus* **82** (1902): 372–374. **Hoffmann.**

Neue Norwegische Bahnen und ihre Bedeutung. Von Dr. B. Hoffmann.

Norway—Snow-limit. *Norske G. Selsk. Aarbog* **13** (1901–1902): 59–73. **Hansen**

Snegrænsen i Norge. Af dr. Andr. M. Hansen. *With Map and Diagram.*

See note in Monthly Record for March (p. 316).

Russia. **Bonmariage.**

La Russie d'Europe. Topographie, relief, géologie, hydrologie, climatology, régions naturelles, les peoples et leur mode de répartition. Essai d'Hygiène Générale. Par le Dr. A. Bonmariage. Paris: Le Soudier, 1903. Size 11 × 7½, pp. viii. and 560. *Maps and Illustrations. Price* 20*s.*

Russia. *B.S.G. Lille* **38** (1902): 341–363. **Patouillet.**

L'Est de la Russie d'Europe. Par J. Patouillet.

Russia—Iron Industry. *J.S. Arts* **51** (1902): 74–91. **Head.**

The South Russian Iron Industry. By Archibald P. Head. *With Maps and Illustrations.*

Russia—Ural. *C. Rd.* **135** (1902): 1135–1137. **Duparc.**

Sur l'origine de la coupure transversale de la Kosva (Oural du Nord). Note de Louis Duparc.

Spain—Historical. *B.S.G. Lisboa* **20** (1902): 67–84. **Garofalo.**

Sulla geografia della Penisola Iberica nella età romana. Pelo Prof. Francisco P. Garofalo.

Sweden. ———

Exkursion nach Süd-Schweden (Schonen) am 20.—24. Mai 1902. Greifswald, 1902. Size 9 × 6, pp. 16. *Maps.*

Sweden—Agriculture. *Ymer* **22** (1902): 305–360. **Högbom.**

Om norra Sverige såsom jordbruksland. Af A. G. Högbom. *With Map.*

See note, *ante*, p. 75.

Switzerland. **Rittener.**

Matériaux pour la Carte Géologique de la Suisse publiés par la Commission Géologique de la Société Helvétique des Sciences Naturelles aux frais de la Confédération. Nouvelle Série: XIII^e^ Livraison. Etude géologique de la Côte-aux-Fées et des environs de Ste-Croix et Baulmes. Par Th. Rittener. Berne: Schmid & Francke, 1902. Size 12½ × 9½, pp. vi., 116, and x. *Map and Profiles. Price* 15 *fr. Presented by the Publisher.*

Switzerland. ———

Annuaire Statistique de la Suisse. Publié par le Bureau de Statistique du Département Fédéral de l'Intérieur. Onzième Année, 1902. Bern: Stämpfli & Cie., 1902. Size 10 × 6½, pp. 342. *Diagrams.*

Switzerland—Geneva. *B.G. Hist. et Descriptive* (1902): 276–281. **Fauvel.**

Le nouveau plan de la ville et de la commune de Genève. Par E. Fauvel.

Switzerland—Geographical Dictionary. **Knapp, Borel, and Attinger.**

Geographisches Lexikon der Schweiz mit dem Beistande der Geographischen Gesellschaft zu Neuenburg herausgegeben unter der Leitung von Charles Knapp, Maurice Borel, und V. Attinger, Deutsche Ausgabe besorgt von Heinrich Brunner. Erster Band. Aa—Emmengruppe. Neuenburg: Gebrüder Attinger, 1902. Size 11 × 7½, pp. xii. and 704. *Maps and Illustrations. Presented by Dr. H. Brunner.*

Contains a great deal of valuable matter, both geographical and statistical. The treatment of the morphology of the lakes is especially good.

United Kingdom. *Petermanns M.* **48** (1902): 230–234. **Koffmahn.**

Eine neue Karte von Grossbritannien und Irland. Von Otto Koffmahn.

A detailed account of the method of preparation of the new map of the British Isles in Stieler's 'Hand-Atlas.' The author passes some strong criticisms on the Ordnance Survey maps, but his statements are in most cases quite unfounded (see *ante*, p. 448).

United Kingdom—Cornwall. *Geolog. Mag.* **10** (1903): 19–25. **Kennard and Warren.**

The Blown Sands and Associated Deposits of Towan Head, near Newquay, Cornwall. By A. S. Kennard and S. H. Warren.

United Kingdom—Ireland. *P.R. Irish A.* **24**, Sec. B. (1902): 95–202. **O'Reilly.**

On the Waste of the Coast of Ireland as a Factor in Irish History. By J. P. O'Reilly.

United Kingdom—Ireland—Botany. *P.R. Irish A.* **24**, Sec. B. (1902): 1–60. **Praeger.**

On Types of Distribution in the Irish Flora. By R. Lloyd Praeger. *With Diagrams.*

See abstract in January *Journal* (pp. 50–62, with maps).

United Kingdom—Ireland—Botany. *P.R. Irish A.* **24**, Sec. B. (1902): 61–94. **Praeger.**

Gleanings in Irish Topographical Botany. By R. L. Praeger.

United Kingdom—Scotland. *Scottish G. Mag.* **19** (1903): 27–37. **Macbean.**

Ancient Fife: seen through its Place-Names. By L. Macbean.

United Kingdom—Temperature. ———

Temperature Tables for the British Islands. Supplement. Difference Tables for each Five Years for the extrapolation of Mean Values. London: Eyre & Spottiswoode, 1902. Size 12½ × 10, pp. viii. and 36. *Price* 3*s*. *Presented by the Meteorological Office.*

ASIA.

Arabia. *B. Comité l'Asie Française* **3** (1903): 13–21. **Imbart de la Tour.**

Autour de l'Arabie. Par J. Imbart de la Tour.

On the present political position in Arabia.

Central Asia. *La G., B.S.G. Paris* **6** (1902): 69–74. **Hedin.**

Mon dernier voyage en Asie centrale. Par Sven Hedin. *With Map.*

Central Asia. *B.S.G. Marseille* **26** (1902): 285–296. **Levat.**

Les résultats de l'expédition française scientifique et minière en Boukharie et au Turkestan, en 1909. Par E. D. Levat. *With Map.*

Ceylon—Botany. *J. Ceylon Br. R. Asiatic S.* **17** (1902): 89–256. **Lewis.**

A Descriptive Catalogue of the more useful Trees and Flowering Plants of the Western and Sabaragamuwa Provinces of Ceylon. By F. Lewis. *With Maps.*

China. *B.S.G. Rochefort* **24** (1902): 302–323. **Ballande.**

Six mois sur les rivières du Pé-Tchéli. Par C. Ballande.

Chinese Empire—Eastern Turkestan. *Petermanns M.* **48** (1902): 288–290. **Himly.**

Sven Hedins Ausgrabungen am alten Lop-nur. Von K. Himly.

Eastern Asia. *Petermanns M.* **48** (1902): 261–265. **Futterer.**

Prof. F. v. Richthofens Geomorphologische Studien aus Ostasien. Von Prof. Dr. K. Futterer.

Eastern Asia—Bibliography. **Barthold.**

Russische Arbeiten über Ostasien: Jahresbericht für 1901. Von W. Barthold. (Mittheilungen des Seminars für Orientalische Sprachen zu Berlin. Jahrg. V. Erste Abth. Ostasiatische Studien. Pp. 155–162.) Berlin: G. Reimer, 1902. Size 10 × 7.

Eastern Asia—Treaties. **Reinach.**

L. de Reinach. Recueil des Traités conclus par la France en Extrême-Orient (1684–1902). Paris: E. Leroux, 1902. Size 10 × 6½, pp. 442. *Price* 15*s*.

French Indo-China. **Pavie and Lefèvre-Pontalis.**

Mission Pavie Indo-Chine 1879–1895. Géographie et Voyages. V. Voyages dans le Haut Laos et sur les frontières de Chine et de Birmanie. Par Pierre Lefèvre-Pontalis. Introduction par Auguste Pavie. Paris: E. Leroux, 1902. Size 11 × 9, pp. xlviii. and 328. *Maps and Illustrations.*

This will be specially noticed.

French Indo-China—Cambodia. **Lajonquière.**

Inventaire descriptif des Monuments du Cambodge. Par E. Lunet de Lajonquière. Paris: E. Leroux, 1902. Size 11 × 7½, pp. cvi. and 430. *Illustrations.*

French Indo-China—Laos. *B.S.G. Com. Paris* **24** (1902): 273–287. **Audoüin.**

Quelques notes sur la province du Tran-Ninh (Laos). Par H. Audoüin. *With Map.*

French Indo-China—Tongking. **Girod.**

Miss. Catholiques **34** (1902): 472–475, 485–490, 497–500, 510–514, 526–528, 533–537. Une tournée dans la région située au N.-O. de Lao-Kay. Par M. Girod. *With Map and Illustrations.*

India. **Forrest.**

Cities of India. By G. W. Forrest. Westminster: A. Constable & Co., Ltd., 1903. Size 9 × 5½, pp. xvi. and 354. *Map and Illustrations. Price* 10*s.* 6*d. net. Presented by the Publishers.*

India. *Rev. G.* **51** (1902): 344–365, 422–446. **Malleterre.**

L'Empire anglais des Indes, Étude historique et politique. Par Commandant Malleterre.

India—Assam. **Oldham.**

On Tidal Periodicity in the Earthquakes of Assam. By R. D. Oldham. (Extract from the *Journal of the Asiatic Society of Bengal*, vol. lxxi. pp. 139–153, 1902.) Calcutta, 1902. Size 9½ × 6½. *Presented by the Author.*

This is noticed in the Monthly Record (*ante*, p. 451).

India—Burma. **Hertz.**

A Practical Handbook of the Kachin or Chingpau Language, containing the Grammatical Principles and Peculiarities of the Language, Colloquial Exercises, and a Vocabulary, with an Appendix on Kachin Customs, Laws, and Religion. By H. F. Hertz. Rangoon, 1902. Size 10½ × 7, pp. v. and 164. *Price* 1*s.* 9*d. Presented by the Author.*

India—Census. **Bannerman.**

Census of India, 1901. Vol. xxv. Rajputana. Part i. Report, by Captain A. D. Bannerman (Lucknow, 1902, pp. iv. and 220). Vol. xxv.–A. Rajputana. Part ii. Imperial Tables, by Captain A. D. Bannerman (Lucknow, 1902, pp. 746). *Maps and Diagrams. Presented by the Indian Government.*

India—Census. **Lowis.**

Census of India, 1901. Vol. xiiA. Burma. Part ii. Imperial Tables. By C. C. Lowis. Rangoon, 1902. Size 13 × 8½, pp. 432. *Diagram. Presented by the Indian Government.*

India—Forests. *J.R. Colonial I.* **34** (1903): 173–191. **Gamble.**

The Forests of India and their Management. By J. S. Gamble.

India—Geological Survey. **Griesbach.**

General Report on the Work carried on by the Geological Survey of India for the period from April 1, 1901, to March 31, 1902. Under the direction of C. L. Griesbach. Calcutta, 1902. Size 10½ × 7½, pp. 36. *Presented by the Geological Survey of India.*

India—Historical. *B. l'Ecole Française d'Extrême-Orient* **2** (1902): 256–259. **Huber.**

L'Itinéraire du pélerin Ki Ye dans l'Inde. Par Edouard Huber.

India—Madras—Rainfall. *Monthly Weather Rev.* **30** (1902): 438–440. **Rao.**

The Rainfall in the City of Madras and the Frequency of Sun Spots. By M. B. Subha Rao. *With Diagram.*

India—Panjab. **Maclagan.**

Gazetteer of the Multan District. By E. D. Maclagan, 1901–02. Revised Edition. Lahore, 1902. Size 9 × 6½, pp. ix. and 388 and lxx. *Map. Price* 5*s. Presented by the Secretary of State for India.*

India—Survey. ———

Synopsis of the Results of the Operations of the Great Trigonometrical Survey of India. Vol. xix. Descriptions and Co-ordinates of the Principal and Secondary Stations and other fixed points of the Great Arc—Section 8° to 18° or Series A of the Southern Trigon. Dehra Dun, 1899. Size 12½ × 10, pp. x., xiv., and 322. *Charts and Diagram.*

Japan. **Dumolard.**

Henry Dumolard. Le Japon politique, économique et social. Paris: A. Colin, 1903. Size 7½ × 5, pp. viii. and 344. *Price* 4 *fr. Presented by the Publishers.*

See Review in March number (p. 305).

Japan. *Petermanns M.* **48** (1902): 245–253. **Yamasaki.**

Morphologische Betrachtung des japanischen Binnenmeers Setouchi. Von Dr. N. Yamasaki. *With Map.* (See note, *ante*, p. 453.)

Japan—Tobacco. **Lehmann**
M. Deutsch. Ges. Natur- u. Völkerk. Ostasiens **9** (1902): 57–78.
Der Tabak, sein Bau und seine Weitere Behandlung in Japan. Von Dr. Max Lehmann.

Korea. *B.S.G. Com. Paris* **24** (1902): 225–259. **De Lapeyrière.**
La Corée. Par M. De Lapeyrière.

Malay Archipelago—Celebes. *Globus* **83** (1903): 45–47. **Sarasin.**
Weitere Reisen der Herren Sarasin in Celébes. Von Palu nach Paloppo.

Malay Peninsula. *J.R. Colonial I.* **34** (1903): 75–105. **Clifford.**
British and Siamese Malaya. By Hugh Clifford, C.M.G.

North-East Asia. **Zabel.**
Durch die Mandschurei und Sibirien. Reisen und Studien von Rudolf Zabel. Leipzig: G. Wigand, 1902. Size 11 × 8, pp. xii. and 314. *Portrait and Illustrations. Price* 20*s.*

Persia. *J.S. Arts* **51** (1902): 95–105. **Sykes.**
Domestic Life in Persia. By Miss Ella C. Sykes.

Persia—Khorassan and Sistan. **Whyte and Benn.**
Trade of Khorassan and Sistan for the year 1901–02. Foreign Office, Annual No. 2921, 1902. Size 10 × 6½, pp. 44. *Price* 2½*d.*

Russia—Siberia. **Cooke.**
Trade of Siberia. Foreign Office, Miscellaneous No. 585, 1902. Size 10 × 6½, pp. 26. *Price* 2*d.*

Russia—Siberia. *Questions Dipl. et Colon.* **14** (1902): 746–760. **Labbé.**
La région du fleuve Amour: la province Maritime. Par Paul Labbé. *With Map.*

Russia—Siberia. *Petermanns M.* **48** (1902): 234. **Toll.**
Die Aufnahme der Taimyr-Bai 1900–01. Durch Baron E. Toll. *With Map.*

Russian Central Asia—Lake Aral. **Berg.**
Zur Morphologie der Ufern des Aral-Meeres. Von L. Berg. (Extrait de *Annuaire géologique et minéralogique de la Russie* (vol. v. Livr. 6–7), édité et rédigé par N. Krichtafowitsch). [In Russian.] Varsovie, 1902. Size 12½ × 9½, pp. 181–196. *Plates. Presented by the Author.*
This was noticed in the Monthly Record for March (p. 317).

Russian Central Asia—Lake Aral. *Petermanns M.* **48** (1902): 260–261. **Woeikow.**
Ueber den Aral-See. Von Prof. Dr. A. Woeikow.

Siam. *Toung Pao* **3** (1902): 240–247. **Suzor.**
Le Laos Siamois. Par M. Suzor.

South-East Asia—Historical. **Gerini.**
Imp. and Asiatic Quarterly Rev. **11** (1901): 379–385; **13** (1902): 119–147, 361–368; **14** (1902): 391–407.
Siam's Intercourse with China. (Seventh to Nineteenth Centuries.) By Major G. E. Gerini.

Turkey—Arabia. **Forder.**
With the Arabs in Tent and Town. An Account of Missionary Work, Life and Experiences in Moab and Edom and the First Missionary Journey into Arabia from the north. By A. Forder. London: Marshall Brothers, 1902. Size 8 × 5, pp. xii. and 244. *Map and Illustrations.*
From a geographical point of view the interest centres in the journey to the Jof, which has already been described in the *Journal* (vol. xx. p. 619).

Turkey—Asia Minor. *Petermanns M., Ergänzungsheft Nr.* **140** (1902): pp. 90. **Fitzner.**
Niederschlag und Bewölkung in Kleinasien. Von Dr. Rudolf Fitzner. *With Map.*

Turkey—Palestine. **Hull.**
Palestine Exploration Fund, Quarterly Statement (1903): 92–93.
Notes on Prof. Libbey's Account of the Jordan Valley and Petra. By Prof. Hull.
The writer considers that Prof. Libbey's assumptions (in his paper read at Belfast) are "based on little or no evidence."

Western Asia—Bibliography. **Barthold.**

Russische Arbeiten über Westasien. Jahresbericht für 1901. Von W. Barthold. (Mittheilungen des Seminars für Orientalische Sprachen zu Berlin. Jahrg. V. Zweite Abth. Westasiatische Studien. Pp. 25–47.) Berlin: G. Reimer, 1902. Size 10 × 7.

AFRICA.

Abyssinia. *Nineteenth Century* **53** (1903): 79–97. **Berkeley.**

The Abyssinian Question and its History. By G. F. H. Berkeley.

Abyssinia. *Questions Dipl. et Colon.* **15** (1903): 129–142. **Terrier.**

La délimitation de l'Ethiopie. Par A. Terrier. *With Map.*

Africa—Forests. **Breschin.**

La G., B.S.G. Paris **5** (1902): 431–450; **6** (1902): 27–39, 218–237.

La forêt tropicale en Afrique principalement dans les Colonies françaises. Par A. Breschin. *With Maps.*

Africa—Minerals. **Launay.**

Les Richesses Minérales de l'Afrique. L'or, les metaux, le diamant, les phosphates, le sel, les combustibles, les sources thermales, etc. Algérie et Tunisie. Égypte, Abyssinie, Soudan, Côte d'Or, Transvaal, Rhodésia, Afrique Centrale, Madagascar, etc. Par L. de Launay. Paris: C. Béranger, 1903. Size 10 × 6. pp. 416. *Price* 16*s.* 9*d. Maps and Illustrations.*

Africa—Tsetse Fly. *Beiträge Kolonialpolitik* **4** (1902–1903): 263–271. **Lichtwardt.**

Ueber die Tsetse. Von B. Lichtwardt. *With Plate.*

Algeria. *Ann. G.* **11** (1902): 221–246, 339–365, 419–438. **Bernard and Ficheur.**

Les Régions naturelles de l'Algérie. Par Augustin Bernard et Émile Ficheur, accompagné d'une note cartographique par René de Flotte Roquevaire. *With Maps and Profiles.*

British East Africa—Uganda. **Austin.**

With Macdonald in Uganda. A Narrative Account of the Uganda Mutiny and Macdonald Expedition in the Uganda Protectorate and the Territories to the North. By Major Herbert H. Austin. London: E. Arnold, 1903. Size 9½ × 6. pp. xvi. and 314. *Map and Illustrations. Presented by the Publisher.*

British East Africa—Uganda. **Mahon.**

Exotic Plants of Economic Interest in the Botanic Gardens at Entebbe, Uganda. Foreign Office, Miscellaneous, No. 588, 1903. Size 9½ × 6½, pp. 8. *Price* ½*d.*

Egypt. **Beadnell.**

Survey Department, Public Works Ministry, Egypt. Geological Survey Report. 1900. Part ii. The Cretaceous Region of Abu Roash near the Pyramids of Giza. By Hugh J. L. Beadnell. Cairo: National Printing Department, 1902. Size 11 × 7½, pp. 48. *Maps and Plates.*

Egypt—Nile. *Z. Ges. Erdk. Berlin* (1902): 694–722, 753–762. **Blanckenhorn.**

Die Geschichte des Nil-Stroms in der Tertiär- und Quartärperiode, sowie des palæolithischen Menschen in Ägypten. Von Dr. Max Blanckenhorn. *With Maps.*

Eritrea. *Rer. G. Italiana* **9** (1902): 537–564. **Loperfido.**

Notizie sulla triangolazione dell' Eritrea. A. Loperfido. *With Diagram and Illustration.*

French Congo. *Meteorolog. Z.* **19** (1902): 509–512. **Hann.**

Klima am oberen Schari im französischen Sudan. Von J. Hann.

French West Africa. *La G., B.S.G. Paris* **7** (1903): 19–31. **Barot.**

L'Afrique occidentale française et ses conditions d'habitabilité. Par Dr. Barot. *With Maps.*

German East Africa. **Schmidt.**

Deutsch. Kolonialblatt **13** (1902): 335–336, 365–367, 411–413, 438–440, 463–465, 489–491, 519–520, 541–543.

Das Kameel als Transportmittel in Deutsch-Ostafrika. Von Thierarzt Schmidt.

German East Africa. *Deutsch. Kolonialblatt* **13** (1902): 437–438. **Wendt.**

Wami- und Mligazibereisung.

On an expedition to test the navigability of the Wami.

German South-West Africa. *M. Deutsch. Schutzgeb.* **15** (1902): 182–188. **Ambronn.**
Resultate der geographischen Ortsbestimmungen von Dr. G. Hartmann in Deutsch-Südwestafrika. Berechnet von Prof. Dr. Ambronn.

German South-West Africa. **Jodtka.**
Deutsch. Kolonialblatt **13** (1902): 493–495, 524–526, 546–548, 590–592.
Reise des Assistentarztes Jodtka nach dem Okavango. *With Map.*

German South-West Africa. *M. Deutsch. Schutzgeb.* **15** (1902): 181. **Schnauder.**
Ergebnisse der astronomischen Ortsbestimmungen in Deutsch-Südwestafrika von Oberleutnant Freiherrn v. Fritsch. Berechnet von Prof. Schnauder.

Gold Coast. **Attrill.**
Gold Coast. Report for 1901. Colonial Reports, Annual No. 375, 1902. Size 9½ × 6, pp. 36. *Price* 2½*d.*

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Ueber Ortsnamen in Kamerun. Von E. Dinkelacker.

Kamerun. *Deutsch. Kolonialblatt* **13** (1902): 543–546, 588–590. **Pavel.**
Oberst Pavel über seine Expedition nach dem Tsadsee.

Kamerun. *Deutsch. Kolonialblatt* **13** (1902): 440–443. **Stein.**
Bericht des Oberleutnants Frhrn. v. Stein über die Bertua-Expedition.

Madagascar. *Rev. Madagascar* **4** (1902): 549–553. **Imbert.**
Impressions de voyage, au pays de l'Androy ou brousse épineuse. Par Lieutenant E. Imbert. *With Illustrations.*

Madagascar—Majunga. *Rev. Madagascar* **4** (1902): 521–548. **Moriceau.**
Le Nord de la province de Majunga. Par L. Moriceau. *With Illustrations.*

Madagascar—Railway. *Rev. Madagascar* **4** (1902): 481–513. ——
Une date dans l'histoire économique de Madagascar. Inauguration du premier tronçon du chemin de fer de la côte orientale à Tananarive. *With Illustrations.*

Morocco. **Doutté**
Renseignements Colon., Comité l'Afrique Française, No. 8 (1902): 157–164.
Troisième voyage d'études au Maroc, rapport sommaire d'ensemble de Edmond Doutté. *With Map.*

Morocco. *M.G. Ges. Jena* **20** (1902): 1–105. **Pfeil.**
Geographische Beobachtungen in Marokko. Von Joachim Grafen von Pfeil.

Morocco. *La G., B.S.G. Paris* **7** (1903): 32–37. **Roquevaire.**
Voyages au Maroc du Marquis de Segonzac. Par René de Flotte Roquevaire. *With Map.*

Niger. *La G., B.S.G. Paris* **7** (1903): 71–74. **Lenfant.**
Mission du capitaine Lenfant, commandant la flottille du bas Niger. *With Map.*

Portuguese West Africa. **Nightingale.**
Trade of the Province of St. Thomé and Principe. Foreign Office, Annual No. 2922, 1902. Size 10 × 6, pp. 24. *Price* 1½*d.*

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Sur les terrains paléozoïques de l'Oued Saoura et du Gourara. Note de E. F. Gautier.

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Trente jours au Mouydir. Par le lieutenant E. Réquin. *With Map.*
Noticed in the Monthly Record for March (p. 322).

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Sahara: Le raid du lieutenant Cottenest. Par C. R. *With Map.*

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South Africa and its Future, edited by Louis Creswicke. Contributors:—The Duke of Argyll, K.T., Hon. A. Wilmot, E. F. Knight, etc. London & Edinburgh: T. C. & E. C. Jack, 1903. Size 10 × 6½, pp. 200. *Maps and Illustrations. Price 7s. 6d. net. Presented by the Publishers.*

South Africa—Surveys. *M. Deutsch. Schutzgeb.* **15** (1902): 250–260. **Görgens.**
Das Landvermessungs- und Fortschreibungs-System der Kapkolonie und seine modifizirte Anwendung in Deutsch-Südwestafrika. Nach einem Bericht von Regierungslandmesser H. Görgens.

Togo. *M. Deutsch. Schutzgeb.* **15** (1902): 171–172. **Sprigade.**
Begleitworte zu E2 (Lome) der Karte von Togo, 1: 200,000. (No. 5.) Von P. Sprigade. *With Maps.*

West Africa. *La G., B.S.G. Paris* **7** (1903): 58–60. **Chesneau.**
La zone frontière Loango-Cabinda, d'après les travaux de la Commission franco-portugaise de délimitation. Par M. Chesneau. *With Map.*

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Affairs of West Africa. By Edmund D. Morel. London: W. Heinemann, 1902. Size 9 × 5½, pp. xv. and 382. *Maps and Illustrations. Price* 12*s.*

West Africa—Cotton Cultivation. *J. African S.* **2** (1902): 1–10. **Helm.**
The cultivation of cotton in West Africa. By Elijah Helm.

NORTH AMERICA.

Alaska—Mt. McKinley. *National G. Mag.* **14** (1903): 30–35. **Brooks and Reaburn.**
Plan for Climbing Mt. McKinley. By A. H. Brooks and D. L. Reaburn. *With Map.*

Canada. *J.R. Colonial I.* **34** (1903): 139–172. **Hickman.**
The Canadian West and North-West. By W. A. Hickman.

Canada—Nova Scotia. *T. Nova Scotian I. Sci.* **10** (1900–1901): 361–375. **Haycock.**
The Geological History of the Gaspereau Valley, Nova Scotia. By Prof. E. Haycock. *With Section.*

Canada—Nova Scotia. *T. Nova Scotian I. Sci.* **10** (1900–1901): 379–398. **Mackay.**
Phenological Observations of the Botanical Club of Canada, 1900; Abstract of Phenological Observations on Flowering of ten Plants in Nova Scotia, 1900, with Remarks on their Phenochrons. By Dr. A. H. Mackay. *With Diagrams.*

North and Central America. **Ridgway.**
B. United States Nat. Museum 50 (1902): pp. xx. and 834.
The Birds of North and Middle America. By R. Ridgway. Part ii. *With Plates.*

United States.
Annual Reports of the Department of the Interior for the Fiscal Year ended June 30, 1900. Report of the Commissioner of Education. 2 vols. Pp. lxxx. and 2648.
Ditto, June 30, 1901. Indian Affairs. Parts i. and ii., pp. (Part i.) x. and 806; (Part ii.) 894. Miscellaneous Reports. Parts i. and ii., pp. (Part i.) 744; (Part ii.) 722. Washington, 1901–1902. Size 9½ × 6½. *Maps and Illustrations. Presented by U.S. Department of the Interior.*

As usual, these reports, profusely illustrated by maps and photographs, constitute a mine of information on the geography and statistics of various parts of the United States, including Alaska, Hawaii, and Porto Rico. There are some striking representations of the crater of Mauna Loa and its lava-flows, views of Skagway and its wharf, statistics of irrigation in Arizona, reports on the Yosemite, Sequoia and General Grant National Parks (as well as the Yellowstone), with illustrations of the giant trees, and other items too numerous to mention.

United States—Climate. *Monthly Weather Rev.* **30** (1902): 440–442. **Wilson.**
Indian Summer. By W. M. Wilson.

Quotes statistics showing that conditions popularly regarded as characteristic of Indian summer are quite as common in other seasons (cf. *Journal*, vol. xx., p. 458).

United States—Colorado River. **Dellenbaugh.**
The Romance of the Colorado River. The Story of its Discovery in 1540, with an Account of the Later Explorations, and with Special Reference to the Voyages of Powell through the Line of the Great Canyons. By Frederick S. Dellenbaugh. New York and London: G. P. Putnam's Sons, 1902. Size 9 × 6, pp. xxxv. and 400. *With Maps and Illustrations. Price* 15*s. net.*
The writer was a member of the Expedition of 1871–72.

United States—Ohio. *National G. Mag.* **13** (1902): 398–403. **Mosely.**
Submerged Valleys in Sandusky Bay. By Prof. E. L. Mosely. *With Charts.*

United States—Trade. **Hitchcock.**
Sources of the Agricultural Imports of the United States, 1897–1901. By Frank H. Hitchcock. Pp. 132. Distribution of the Agricultural Exports of the United States, 1897–1901. By the same. Pp. 292. (U.S. Department of Agriculture. Section of Foreign Markets—Bulletins Nos. 28 and 29.) Washington, 1902. Size 9 × 6. *Presented by the U.S. Department of Agriculture.*

CENTRAL AND SOUTH AMERICA.

Argentine Republic. *An. Museo Nac. Buenos Aires* **8** (1902): 1–12. **Ameghino.**
Cuadro sinóptico de las formaciones sedimentarias, terciarias y cretáceas de la Argentina en relación con el desarrollo y descendencia de los mamiferos. Por F. Ameghino.

Bolivia and Argentine. *Ymer* **22** (1902): 437–464. **Nordenskiöld.**
Resa i gränstrakterna mellan Bolivia och Argentina. Af E. Nordenskiöld. *With Illustrations.*

Brazil—Ceará. *Meteorolog. Z.* **19** (1902): 552–559. **Draenert.**
Zum Klima des Staates Ceará, Brasilien. Von Prof. F. M. Draenert.

Brazil—Rio Grande do Sul. **Meinhold.**
Beiträge Kolonialpolitik **4** (1902–1903): 284–297.
Bauerliches Leben in São Lourenço (Rio Grande do Sul). Von Hauptmann F. Meinhold.

British Guiana. **King.**
British Guiana. Report for 1901–1902. Colonial Reports, Annual No. 378, 1903. Size 10 × 6½, pp. 38. *Price* 2½*d.*

Chile. *La G., B.S.G. Paris* **6** (1902): 142–149. **Albert.**
Les plantations des dunes de Chauco (Chili). Par Dr. F. Albert.

Colombia—Puracé Volcano. *Scottish G. Mag.* **19** (1903): 57–65. **White.**
Ascent of an Andean Volcano in Eruption. By R. B. White. *With Illustrations.*
The ascent was of the Puracé Volcano near Popayan, and was made in 1868.

Paraguay. *Rev. Francaise* **27** (1902): 505–515, 576–589, 709–717. **Mouchez.**
Une excursion au Paraguay avec le naturaliste Bomplan (1857). Par Contre-Amiral Mouchez.

Peru. *B.S.G. Lima* **12** (1902): 125–155. **Carvajal.**
Rectificación de las coordenadas geográficas de algunos puntos de la via Central. Por el Contralmirante M. Melitón Carvajal. *Also separate copy, presented by the Author.*

Peru.
Immigrant's Guide to Peru (the Central Railway and the Zone of the Pichis). Lima, 1902. English Translation issued by the Peruvian Legation in London. Size 8 × 5½, pp. 58. *Maps and Illustrations.*

Peru. ———
Reseña industrial del Perú. Lima, 1902. Size 10 × 7, pp. 52. *Illustrations.*

Peru—Mantaro. *B.S.G. Lima* **12** (1902): 161–184. **Ráez.**
El Mantaro y sus afluentes. Por Nemesio A. Ráez.

Peru—Railway. *B.S.G. Lima* **12** (1902): 184–194. **Scold.**
Ferrocarril al Marañón. Por el ingeniero Sam. M. Scold.

South America—River Communication. *B.S.G. Lima* **12** (1902): 195–204. **Maúrtua.**
Communicación de las hoyas hidrográficas sud-Americanas. Por el Dr. Victor M. Maúrtua.

South Georgia. *Ymer* **22** (1902): 409–421. **Andersson.**
Antarctics vinterexpedition till Syd-Georgien. Rapport från Svenska sydpolar-expeditionen. Af J. G. Andersson. *With Illustrations.*
Cf. *Journal*, vol. xx. p. 405.

West Indies—Historical. *B.G. Hist. et Descriptive* (1902): 207–252. **Saint-Yves.**
Les premières relations des Antilles françaises et des Antilles anglaises. Por G. Saint-Yves.

West Indies—Martinique. **Heilprin.**

Mont Pelée and the Tragedy of Martinique. A Study of the great Catastrophes of 1902, with Observations and Experiences in the Field, by Angelo Heilprin. Philadelphia and London: J. B. Lippincott & Co., 1903. Size 9½ × 6, pp. xiii. and 336. *Maps and Illustrations. Price* 15*s. net. Presented by the Publishers.* [To be reviewed.]

West Indies—Martinique and St. Vincent. **Russell.**

National G. Mag. **13** (1902): 415–436.

Volcanic Eruptions on Martinique and St. Vincent. By Prof. Israel C. Russell. *With Illustrations.*

West Indies—St. Vincent. *National G. Mag.* **13** (1902): 444–459. **Hovey.**

The Eruptions of La Soufrière, St. Vincent, in May, 1902. By E. O. Hovey. *With Illustrations.*

AUSTRALASIA AND PACIFIC ISLANDS.

Australia. *P.R.G.S. Australasia, S. Australian Br.* **5** (1902): 29–31. **Winnecke.**

Davidson's West Central Australia Exploration. By C. Winnecke.

Australia—Flinders Centenary. ———

P.R.G.S. Australasia, S. Australian Br. **5** (1902): 45–68.

The Flinders Centenary.

New Guinea—Dutch. **Koning.**

Bijd. Taal-, Land- en Volkenk. Ned.-Indië **1** (1903): 250–280.

Eenige gegevens omtrent land en volk der Noord-Oostkust van Ned. Nieuw-Guinea, genaamd Papoea Telandjang, ontleend aan het rapport van D. A. P. Koning. *With Map and Plates.*

New Guinea—German. *Petermanns M.* **48** (1902): 278–286. **Danneil.**

Zwei wenig bekannte Inseln östlich von St. Matthias im Bismarck-Archipel. Von Dr. C. Danneil. *With Maps.*

Samoa. *M.G. Ges. Jena* **19** (1901): 1–52. **Kurze.**

Die Samoaner in der heidnischen Zeit. Von G. Kurze.

Solomon Islands. *Norske G. Selsk. Aarbog* **13** (1901-1902): 23–58. **Nerdrum.**

Indtryk og oplevelser under et 7 aars ophold paa Salomonøerne af J. G. B. Nerdrum. *With Map and Illustrations.*

Solomon Islands. **Woodford.**

British Solomon Islands. Report for 1901-1902. Colonial Reports, Annual No. 372, 1902. Size 9½ × 6, pp. 22. *Price* 1½*d.*

South Australia. **Murray and Maurice.**

P.R.G.S. Australasia, S. Australian Br. **5** (1902): 33–42.

Mr. R. T. Maurice's Expedition North of Fowler's Bay.

See note in *Journal*, vol. xix. p. 760.

Western Australia. *Z. Ges. Erdk. Berlin* (1902): 797–813. **Diels.**

Reisen in West-Australien. Von Dr. Ludwig Diels. *With Illustrations.*

Western Australia. ———

Western Australia. Report of the Department of Mines for the year 1901 [with which is incorporated the Preliminary Report]. Perth, 1902. Size 13½ × 8½, pp. 110 and 106. *Maps and Illustrations. Presented by the Department of Mines, Perth, Western Australia.*

Western Australia—Minerals. **Simpson.**

Western Australia. Geological Survey. Bulletin No. 6, Notes from the Departmental Laboratory. By Edward S. Simpson. Perth, 1902. Size 8½ × 5½, pp. 90. *Illustrations.*

Miscellaneous information on the minerals of Western Australia.

POLAR REGIONS.

Antarctic. *Ann. G.* **11** (1902): 385–406. **Zimmermann.**

Terres, climats et glaciers antarctiques. Par M. Zimmermann.

Arctic—Peary Expedition. *National G. Mag.* **14** (1903): 29. **Peary.**
Peary on the North Pole.

Arctic—Russian Expedition. *Ymer* **22** (1902): 422–424. **Toll.**
Den ryska polarexpeditionens arbeten under år 1901. Af Edv. v. Toll.

Arctic—Sverdrup's Expedition. *Petermanns M.* **48** (1902): 269. **Isachsen.**
Kurze Uebersicht über die Arbeiten der zweiten norwegischen Polarfahrt (*Fram*, Kapitän O. Sverdrup). Mitgeteilt von Rittmeister Gunnar Isachsen. *With Map.*

Arctic—Sverdrup's Expedition. *Ymer* **22** (1902): 529–534. **Nathorst.**
Sverdrup's polar expedition 1898–1902. Af A. G. Nathorst. *With Map.*

Arctic—Sverdrup's Expedition. *La G., B.S.G. Paris* **3** (1902): 243–248. **Rabot**
L'Expédition du Capitaine Otto Sverdrup dans l'Archipel polaire américain. Par C. Rabot.

Arctic Ocean. **Vilkitski.**
Meteorological and Hydrographical observations made in the summer of 1901 by the expedition to the Northern Glacial Ocean under command of Polkovnik Vilkitski. [In Russian.] St. Petersburg, 1902. Size 11 × 8½, pp. iv. and 77.

Greenland. *La G., B.S.G. Paris* **6** (1902): 79–100. **Rabot.**
Les récentes explorations danoises à la côte orientale du Grönland. Par C. Rabot. *With Maps and Illustrations.*
Résumé of papers in the *Meddelelser om Grønland.*

Greenland. *Meddelelser om Grønland* **27** (1902): 1–107. **Amdrup.**
Beretning om Expeditionen til Grønlands østkyst 1898-99 af G. Amdrup. *With Illustrations.*

Greenland. *Meddelelser om Grønland* **27** (1902): 341–352. **Amdrup.**
Hydrografi fra Skibsexpeditionen til Grønlands Østkyst 1900. Af G. Amdrup.

Greenland. *Meddelelser om Grønland* **27** (1902): 153–181. **Hartz.**
Beretning om Skibsexpeditionen til Grønlands Østkyst. For Tidsrummet fra d. 18. Juli til d. 12. September 1900. Af N. Hartz.
See also *Journal*, vol. xx. p. 129.

Greenland. *Meddelelser om Grønland* **27** (1902): 273–303. **Koch.**
Bemærkninger vedrørende de paa Skibsexpeditionen til Grønlands Østkyst 1900 opmaalte Kyststrækninger mellem 69° 20′ N. Br. og 72° 20′ N. Br. Af J. P. Koch. *With Illustrations.*

Greenland. *Meddelelser om Grønland* **25** (1902): 13–42. **Meldorf.**
Fra en Vaccinationsrejse i Egnen omkring Kap Farvel i Efteraaret 1900. Af Gustav Meldorf. (*Résumé* in French, pp. 246–250.)

Greenland. *Meddelelser om Grønland* **27** (1902): 305–340. ———
Résumé af de astronomiske, meteorologiske og magnetiske Observationer samt Nordlysiakttagelser foretagne paa den østgrønlandske Expedition 1898–99.

Greenland—Disco Island. *Meddelelser om Grønland* **25** (1902): 91–239. **Porsild.**
Bidrag til en Skildring af Vegetationen paa Øen Disko tilligemed spredte topografiske og zoologiske Iakttagelser. Af M. P. Porsild. (*Résumé* in French, pp. 251–307.) *With Illustrations.*

Greenland—Zoology. *Meddelelser om Grønland* **21** (1902): 317–521. **Winge.**
Grønlands Pattedyr. Af Herluf Winge. *With Map.*

MATHEMATICAL GEOGRAPHY.

Cartography. **Torbert.**
Maps and Map Making. By John B. Torbert. Reprinted from *Bulletin* of the American Geographical Society, June, 1902. Size 10 × 6¼, pp. 14. *Illustrations.*

Determination of Position. **Güssfeldt.**
Grundzüge der Astronomisch-Geographischen Ortsbestimmung auf Forschungsreisen und die Entwickelung der hierfür massgebenden Mathematisch-Geometrischen Begriffe. Von Prof. Dr. Paul Güssfeldt. Braunschweig: F. Vieweg & Son, 1903. Size 9 × 6, pp. xx. and 378. *Diagrams. Price* 10*m. Presented by the Publishers.*

Surveying Instruments. **Bakhuis.**

Tijds. K. Ned. Aard. Genoots. Amsterdam **20** (1903): 76–86.

De Hodograaf en de Pedograaf van Th. Ferguson. Door L. A. Bakhuis.

PHYSICAL AND BIOLOGICAL GEOGRAPHY.

Geological Formations. *J. Geology* **10** (1902): 691–699. **Keyes.**

Cartographic Representation of Geological Formations. By C. R. Keyes.

Geology—Laterite. *Geolog. Mag.* **10** (1903): 59–69. **Holland.**

On the Constitution, Origin, and Dehydration of Laterite. By T. H. Holland.

Geology—Sedimentary Deposits. *Geolog. Mag.* **10** (1903): 12–18, 72–80. **Blake.**

On the Original Form of Sedimentary Deposits. By the Rev. J. F. Blake. *With Map and Diagrams.*

Geology—Soils. *C. Rd.* **135** (1902): 1353–1355. **André.**

Sur la nature des composés azotés qui existent dans le sol à différentes hauteurs. Note de G. André.

Glaciers. **Rabot.**

Essai de Chronologie des Variations Glaciaires. Par C. Rabot. (Extrait du *Bulletin de Géographie historique et descriptive*, No. 2, 1902.) Paris: Imp. Nationale, 1902. Size 10 × 6½, pp. 48. *Presented by the Author.*

Meteorology—Bibliography. ———

International Catalogue of Scientific Literature. First Annual Issue. F. Meteorology, including Terrestrial Magnetism. London: Harrison & Sons, 1902. Size 8½ × 5½, pp. xiv. and 184. *Price* 15*s.*

In the subject-catalogue the regional subdivision is subordinated to that into the various branches of meteorology, so that the entries relating to any one country are widely scattered. From a geographical point of view this may be thought a drawback, though possibly it best meets the requirements of meteorologists.

Meteorology—Hail Prevention. ———

Jahrb. K.K. Central-Anstalt Meteorolog. u. Erdmagnetismus **39** (1902), *Anhang*, pp. 154.

Bericht über die Internationale Experten-Conferenz für Wetterschiessen in Graz.

Meteorology—Pressure. *P.R.S.* **71** (1902): 134–135. **Lockyer.**

On the Similarity of the Short-period Pressure Variation over Large Areas. By Sir Norman Lockyer, K.C.B., etc., and Dr. W. J. S. Lockyer. *With Diagrams.* [See also *Nature* **67** (1903): 224–226.]

Oceanography. *Z. Ges. Erdk. Berlin* (1902): 763–796. **Meinardus.**

Die oceanologischen Ergebnisse der Valdivia-Expedition. (Nach der Bearbeitung von Dr. Gerh. Schott.) Von Dr. Wilh. Meinardus.

Oceanography. *Petermanns M.* **48** (1902): 217–223, 268. **Schott.**

Die Verteilung des Salzgehalts im Oberflächenwasser der Ozeane. Von Dr. G. Schott. *With Map.*

Oceanography—Atlantic. *La G., B.S.G. Paris* **7** (1903): 1–18. **Bénard.**

Les courants de l'Atlantique Nord et du golfe de Gascogne. Par C. Bénard. *With Maps. Also separate copy, presented by the Author.*

Soils. *Scottish G. Mag.* **19** (1903): 20–27. **Hardy.**

Humus as a Geographical Agency. By Marcel Hardy.

Terrestrial Physics. ———

The National Physical Laboratory. Report for the year 1901. London: Harrison & Sons, 1902. Size 11 × 7½, pp. 54.

Contains reports on magnetic, meteorological, and seismological observations at Kew and elsewhere.

Volcanoes. **Anderson.**

Volcanic Studies in Many Lands, being reproductions of photographs, by the Author, of above one hundred actual objects, with explanatory notices. By Tempest Anderson. London: J. Murray, 1903. Size 10½ × 7½, pp. xxviii. and 202. *Plates. Price* 21*s. net. Presented by the Publisher.*

This is not a systematic treatise on volcanic phenomena, but a series of typical illustrations with descriptions.

ANTHROPOGEOGRAPHY AND HISTORICAL GEOGRAPHY.

Historical—Springer. **Schulze.**

Balthasar Springers Indienfahrt 1505/6. Wissenschaftliche Würdigung der Reiseberichte Springers zur Einführung in den Neudruck seiner "Meerfahrt" vom Jahre 1509 von Franz Schulze. Strassburg: Heitz & Mundel, 1902. Size 8½ × 5½, pp. 100. *Facsimiles. Price* 6*s.*

See Review in March number, p. 315.

Historical—Teixeira. **Sinclair and Ferguson.**

The Travels of Pedro Teixeira; with his 'Kings of Harmuz,' and extracts from his 'Kings of Persia.' Translated and Annotated by William F. Sinclair. With further Notes and an Introduction by Donald Ferguson. London: Hakluyt Society, 1902. Size 9 × 5½, pp. cviii. and 292. *Presented by the Hakluyt Society.*

GENERAL.

Education—Military. ———

Report of the Committee appointed to consider the Education and Training of Officers of the Army, together with Appendix. London: Eyre & Spottiswoode, 1902. Size 13½ × 8½, pp. 150. *Price* 1*s.* 3*d.*

Encyclopædia. **Meyer.**

Meyers Grosses Konversations-Lexikon. Ein Nachschlagewerk des allegemeinen Wissens. Sechste, gänzlich neubearbeitete und vermehrte Auflage. Erster Band. A bis Astigmatismus. Leipzig u. Wien. Bibliographisches Institut, 1902. Size 10 × 6½, pp. viii. and 904. *Maps, Plates, and Illustrations. Price* 9*s.*

French Colonies. **Mourey and Brunel.**

L'Année Coloniale publiée sous la direction de Ch. Mourey et Louis Brunel. Troisième Année (1901). Paris: Société de l'Annuaire Colonial, 1902. Size 9 × 6, pp. 330. *Illustrations. Presented by the Publishers.*

This useful publication now appears for the third time, and the present issue, like its predecessors, supplies an excellent summary of the progress of the French Colonies during the year.

Geography. **Ratzel.**

Die Erde und das Leben. Eine vergleichende Erdkunde von Prof. Dr. Friedrich Ratzel. Zweiter Band. Leipzig und Wien: Bibliographisches Institut, 1902. Size 10½ × 7, pp. xii. and 702. *Maps, Plates, and Illustrations. Presented by the Publishers.*

Germans. **Langhans.**

Deutsche Erde. Beiträge zur Kenntnis deutschen Volkstums allerorten und allerzeiten. Herausgegeben von Prof. Paul Langhans. I. Jahrgang, 1902. Gotha: J. Perthes. Size 10½ × 7½, pp. x. and 182. *Maps. Price* 6*m.*

The first year's issue of a new serial devoted to the study of the Germans throughout the world. The separate articles, mostly dealing with the distribution of Germans in foreign countries, are amply illustrated by maps, both in the text and separate.

Hindustani Language. **Thimm.**

Hindustani Grammar Self-taught. In four parts. I. A Simplified Grammar. II. Exercises and Examination Papers. III. The Vernacular. IV. Key and Dictionary. By C. A. Thimm. London: E. Marlborough & Co., 1902. Size 7 × 4½, pp. 118. *Price* 2*s.* 6*d. Presented by the Publisher.*

As in so many works of the kind, grammatical usages are too often treated as stereotyped facts, without any clear explanation of their *raison d'être*. Confusion of ideas is also sometimes shown, as when *kitne*, "how many?" is put down as an adverb.

Hints to Travellers. **Reynolds-Ball.**

Practical Hints for Travellers in the Near East. A companion to the Guide Books. By E. A. Reynolds-Ball. London: E. Marlborough & Co., 1903. Size 7½ × 5, pp. 140. *Illustrations. Price* 2*s.* 6*d. Presented by the Publisher.*

These hints give practical information on just the points on which it is most needed by tourists.

Mountaineering. **Le Blond.**

True Tales of Mountain Adventure for Non-climbers, Young and Old. By Mrs.

Aubrey Le Blond (Mrs. Main). London: T. Fisher Unwin, 1903. Size 9 × 5½, pp. xviii. and 300. *Illustrations. Price* 10*s.* 6*d. net. Presented by the Publisher.*

The author, herself an enthusiastic mountaineer, has in this work made a judicious selection, from published works, of some of the most stirring episodes in the history of mountain-climbing, and adds some interesting items from her own experiences. There are four chapters on mountaineering in general, glaciers, etc., written for the benefit of the uninitiated.

Mountains. **Grand-Carteret.**

John Grand-Carteret. La Montagne à travers les Ages. Rôle joué par elle: Façon dont elle a été vue. I. Des temps antiques à la fin du dix-huitième siècle. Grenoble: H. F. Falque & F. Perrin, 1903. Size 11½ × 9, pp. xvi. and 560. *Illustrations. Price* 33*s.* 6*d.*

NEW MAPS.

By E. A. REEVES, *Map Curator,* **R.G.S.**

EUROPE.

Balkan Peninsula. **Cvijic.**

T. Cvijic. Die grossen Seen der Balkan-Halbinsel. 10 Karten. Belgrade: Der Akademie der Wissenschaften, 1902. *Presented by the Academy of Sciences, Belgrade.*

There will be a special notice of this portfolio of maps in a future number of the *Geographical Journal.*

Central Europe. **Liebenow and Ravenstein.**

Liebenow-Ravenstein's Special-Radfahrerkarte von Mittel-Europa. Scale 1:300,000 or 4·7 stat. miles to an inch. Sheets—6, Memel; 7, Schawli; 8, Tilsit; 9, Kowno; 10, Tondern; 11, Sonderburg; 15, Stolpmünde; 16, Hela; 17, Königsberg; 18, Insterburg u. Gumbinnen; 19, Suwalki; 20, Tönning; 21, Kiel; 22, Rostock; 23, Stralsund; 24, Colberg; 25, Köslin; 26, Danzig; 27, Elbing; 28, Lötzen; 29, Augustowo; 30, Terschelling; 31, Emden; 32, Wilhelmshaven; 33, Hamburg; 34, Schwerin; 35, Anklam; 36, Stettin; 37, Tempelburg; 38, Bromberg; 39, Deutsch Eylau; 40, Neidenburg; 41, Bialystok; 43, Groningen; 44, Bremen; 45, Lüneburg; 46, Wittenberge; 47, Ruppin; 48, Küstrin; 49, Kreuz; 50, Gnesen; 51, Plock; 53, Siedlee; 56, Zwolle; 57, Minden; 58, Hannover; 59, Magdeburg; 60, Berlin; 61, Frankfurt; 62, Posen; 63, Kalisch; 66, Lublin; 70, Wesel; 71, Arnsberg; 72, Cassel-Göttingen; 73, Halle; 74, Leipzig; 75, Cottbus; 76, Liegnitz; 77, Breslau; 80, Sandomierz; 84, Köln; 85, Marburg-Wetzlar; 86 Eisenach; 87, Erfurt; 88, Chemnitz; 89, Dresden; 90, Hirschberg; 91, Neisse; 92, Beuthen; 98, Prüm; 99, Frankfurt a. M.; 100, Kissingen; 101, Bamberg; 102, Eger; 112, Frier; 113, Mannheim; 114, Würzburg; 126, Nancy; 127, Strassburg. Frankfurt a. M.: Ludwig Ravenstein.

England and Wales. **Ordnance Survey.**

ORDNANCE SURVEY OF ENGLAND AND WALES:—Revised sheets published by the Director-General of the Ordnance Survey, Southampton, from February 1 to 28, 1903.

1 inch:—

With hills in brown or black: 76, 77, 105, 119, 127, 150 (engraved). 1*s. each.*

Printed in colours: 120, 142, 163, 165. 1*s. each.*

6-inch—County Maps:—

Bedfordshire, 13 S.E., 19 N.W. **Cambridgeshire,** 44 S.E., 45 S.E. **Dorset,** 22 N.W., N.E., 31 N.W., S.W., 39 S.W., S.E., 47 S.W., S.E. **Huntingdonshire,** 27 S.E., 28 S.E. **Montgomeryshire,** 5 N.W., 16 S.W., 23 N.W., N.E., 24 N.W., 26 S.W., S.E., 27 N.E., S.E., 29 S.W., 33 S.W. **Shropshire,** 6 N.E., 14 S.E., 17 N.W., 21 N.E., 31 S.W., 32 S.W., 33 S.E., 36 N.E., 39 N.W., 41 N.W., 42 S.W., S.E., 44 S.E. **Staffordshire,** 22 N.E., 35 N.E., 51 N.W., 52 N.W., S.E., 56 N.W., 57 N.W., N.E., S.W., 58 N.W, N.E., S.E. **Warwickshire,** 4*a* S.E.

25-inch—County Maps:—

Cambridgeshire, XIII. 13; XVII. 5; XXIII. 11; XXVII. 3; XXXVI. 3, 7, 8, 11, 12, 16; XLII. 3, 4, 7, 8, 11, 12, 15, 16; XLVII. 14; LIII. 15; LIV. 1, 6, 10,

13; LV. 4, 16; LVII. 3, 4, 7, 8, 11, 12; LVIII. 4, 8; LIX. 1, 2, 6. **Dorsetshire,** VI. 1, 7, 9, 10, 11, 12, 14, 15, 16; XI. 4, 8, 14; XII. 1, 2, 3, 4, 5, 6, 8; XXI. 4; XXIX. 12; LVIII. (2 and 1) 11. **Gloucestershire,** XVII. 13; XXII. 3, 12; XXVI. 6; XXVII. 5, 6, 15; XXXIV. 9, 13; XXXVI. 10, 12. XLI. 1, 2, 9; XLII. 2, 5, 8, 9, 10, 14, 15; XLIII. 1, 2, 4, 5, 6, 10, 14, 15, 16; XLIV. 13, 14; XLV. 5, 13; XLIX. 9; L. 3, 8, 9, 10, 11, 14, 15, 16; LI. 3, 7, 8; LII. 2, 6, 10, 11, 13, 14; LIII. 1, 9; LV. 1, 2, 3; LVI. 1; LVIII. 2, 3, 4, 6, 9, 13; LIX. 4, 7, 8, 9, 14; LX. 1, 5, 6, 9; LXI. 2, 3, 6; LXVI. 5, 9; LXVIII. 12; LXX. 6; LXXIII. 4, 5, 8; LXXIV. 1; LXXVIII. 5, 9. **Leicestershire,** V. 6; IX. 4, 12, 15; X. 5, 10; XVI. 3, 6; XVII. 13; XXII. 8. **Montgomeryshire,** XXXVII. 16; XXXVIII. 9, 11; XLIII. 4, 16; XLIV. 4, 5, 7, 9, 14; XLV. 1, 3; XLVIII. 8, 16; XLIX. 6. **Radnorshire,** I. 16; III. 8, 16; IV. 6; VIII. 1, 5. **Shropshire,** XLVII. 11; LIV. 9, 11; LVII. 14, 15, 16; LVIII. 8; LIX. 14, 15, 16; LXI. 4, 7, 12, 14, 16; LXII. 1, 3, 4, 5, 6, 7, 8, 11, 15, 16; LXIII. 7, 12; LXIV. 5; LXV. 2, 3, 4, 6, 7, 8, 10, 12; LXVI. 9; LXVII. 2, 3, 6, 7, 10, 11, 12, 16; LXVIII. 3; LXX. 2; LXXI. 1. **Somersetshire,** VII. 15; VIII. 9, 10, 13 LXXXIV. 1, 2, 3, 4, 7, 10, 11, 12, 14, 15; LXXXVII. 1, 2, 6, 8; XC. 14. **Staffordshire,** XLII. (4 and 3); XLIII. 1, 5, 9, 13; XLIX. 2, 5, 6, 7, 9, 12; LV. 4; LXII. 14, 16; LXIII. 9, 10; LXV. 10; LXVII. 1, 2, 6; LXX. 3, 7, 15; LXXIV. 2. **Suffolk,** XLII. 3 (areas of Exning parish only); XLII. 7 (areas of Exning parish only). **Warwickshire,** III. 9; V. 10. **Worcestershire,** III. 15; VIII. 2, 9, 13; XIV. 13, 15, 16; XV. 13, 14, 15, 16; XXI. 2, 3, 6, 7, 10, 11; XXII. 3, 5, 6, 9, 12. **Worcestershire** (Det. No. 6), LXII. 3. **Worcestershire** (Det. No. 7), LXII. 12. **Yorkshire,** CCLXXXIII. 8; CCLXXXIV. 2, 12; CCLXXXVI. 1; CCLXXXIX. 4; CCXCV. 4, 8, 16.

1-inch—Miscellaneous Maps:—

Petty Sessional Divisions in colour:—London, County of. 6*d.*

England and Wales. **Geological Survey.**

Maps (1-inch). New Series (colour-printed). Sheet 298 (Salisbury), Drift Edition. 1*s.* 6*d.* (with explanations).

Memoirs:—

Index to Report on the Geology of Cornwall, Devon, and West Somerset. 1*s.*
Isle of Man, Geology of the. 12*s.*
Salisbury, Geology of the Country around (Explanation of Sheet 298). 1*s.* 3*d.*

(*E. Stanford, London Agent.*)

England and Wales. **Bartholomew.**

The Survey Atlas of England and Wales. A series of eighty-four plates of maps and plans, with Descriptive Text, illustrating the Topography, Physiography, Geology, Climate, and the Political and Commercial Features of the Country. Designed by and prepared under the direction of J. G. Bartholomew, F.R.S.E., F.R.G.S. Part 2. Edinburgh: John Bartholomew & Co. Under the Patronage of the Royal Geographical Society, 1903. *Price* 2*s.* 6*d. each part. Presented by the Publishers.*

A notice of this atlas appeared in the *Geographical Journal* for February last. The present part, No. 2, contains the following maps: 10, Ecclesiastical and Parliamentary Maps; 27, Section xvi., Liverpool and Denbigh; 70, Section lix., Dorset and Portland; 71, Section lx., Southampton and Isle of Wight.

Norway. **Norges Geografiske Opmaaling.**

Topografisk kart over kongeriget Norge. Scale 1: 100,000 or 1·5 stat. miles to an inch. Sheets: 3-D, Egersund; 5-A, Kristiansand; 14-D, Kristiania; 32-B, Tryssil; 32-D, Engerdalen; 55-B, Fraaholmen; 48-D, Tarbuskjær; G-19, Sklinden; H-18, Vega; H-19, Helgelandsflesa; H og I 12, Röst; I 10, Moskenesöen; I 19, Bindalen; J 9, Kvalnes; J 10, Vestvaagö; J 14, Melö; J 15, Svartisen; J 19, Börgefjeld; K 10, Svolvær; K 15, Dunderlandsdalen. 1900–1901.—*Price kr.* 0.60. Generalkart over det sydlige Norge. Scale 1: 400,000 or 6·3 stat. miles to an inch. Sheets: XII., XIV., XVII. 1901.—*Price kr.* 0.60. Kart over Söndre Trondhjems Amt. Scale 1: 200,000 or 3·1 stat. miles to an inch. Sheet I. 1901. *Price kr.* 1.00.—Specialkart over den Norske Kyst fra Ure til Brettesnes. Scale 1: 50,000 or 0·78 stat. mile to an inch. 1902. *Price kr.* 1.00.—Specialkart over Havne i Finmarken. Scale 1: 50,000 or 0·78 stat. mile to an inch. Bladd I. and II. 1901–1902. *Price kr.* 1.00. Christiania: Norges Geografiske Opmaaling. *Presented by l'Institut Géographique de Norvège.*

ASIA.

China. **Königl. Preuss. Landes-Aufnahme.**

Karte von Ost-China. Scale 1 : 1,000,000 or 15·8 stat. miles to an inch. Kartographische Abtheilung der Königl. Preuss. Landes-Aufnahme, 1902. Sheets: "Futschau," "Hsi ngan fu," "Nan tschang fu," "Yi tschang fu," "Yü lin fu."

AFRICA.

Africa. **Intelligence Division, War Office.**

Africa. Scale 1 : 250,000 or 3·9 stat. miles to an inch. Egyptian Sudan. Sheets: (Provisional) 46-M, Maman; (Provisional) 55-A, El Safia; (Provisional) 55-F, Ma'atuk; (Provisional) 55-G, Wad Medani. London: Intelligence Division, War Office; Stanford. 1902. *Price* 1*s.* 6*d. each sheet. Presented by the Director-General of Mobilization and Military Intelligence.*

Africa. **Friedrich.**

Produkten- und Verkehrskarte von Afrika. Bearbeitet von Dr. Ernst Friedrich. Scale 1 : 10,000,000 or 157·8 stat. miles to an inch. 3 Blätter, nebst einer Beigabe, Literaturverzeichnis und Statistik enthaltend. Bielefeld und Leipzig: Velhagen & Klasing, 1903. *Price* 9*m.*

A general map of Africa in three sheets, showing, by means of different colours, symbols, and lettering, the distribution of various minerals, and agricultural and animal products that have a commercial importance, as well as trade routes, steamer and telegraph lines, railways, anchorages, coaling stations, and other information of a similar character. Ten pages of letterpress accompany the map, giving the exports and imports of the various estates for the years 1899 and 1900. A list of the authorities consulted in the compilation of the map is also given. The map contains a vast amount of useful information, but it is so crowded with symbols that it is difficult to read.

German South-West Africa. **Nobiling.**

Wirtschafts- und Verkehrskarte von Deutsch-Südwestafrika. Scale 1 : 2,000,000 or 31·5 stat. miles to an inch. Gezeichnet von H. Nobiling. Berlin: Dietrich Reimer (Ernst Vohsen), 1903. *Presented by the Publisher.*

West Africa. **Meunier.**

Carte de la Guinée Française. Dressée par A. Meunier. Scale 1 : 500,000 or 7·8 stat. miles to an inch. 4 sheets. Ministère des Colonies. Service Géographique et des Missions. M. Camille Guy, Chef du Service. Paris: H. Barrère, [1903].

This map includes the area between 8° and 13° N. lat., and between 7° 40′ and 15° 40′ W. long. It has been compiled from the route surveys of many explorers, the names of forty-three being mentioned, and from the British and French Admiralty Charts. It is printed in colours, routes being in red and water blue. A full explanation of the symbols employed is given.

AMERICA.

Canada. **Surveyor-General's Office, Ottawa.**

Sectional Map of Canada. Scale 1 : 190,080 or 3 stat. miles to an inch. Souris Sheet (33), West of Second Meridian; revised to January 9, 1903: Yorkton Sheet (36), West of Second Meridian; revised to August 7, 1902: Prince Albert North Sheet (47), West of Second Meridian; revised to November 7, 1902: the Elbow Sheet (52), West of Third Meridian; revised to December 10, 1902. Ottawa: Surveyor-General's Office. *Presented by the Surveyor-General of Canada.*

Nova Scotia. **Government of Nova Scotia.**

Map of Nova Scotia. Scale 1 : 506,880 or 8 stat. miles to an inch. Published by order of the Government of Nova Scotia. Halifax, N.S.: A. & W. Mackinlay; London: G. Philip & Son. 1902. *Presented by the High Commissioner for Canada.*

A good general map of Nova Scotia, printed in colours and showing, in addition to topographical features, counties, railways, roads, and the location of minerals. Tables of the area and population of the different counties, and of the estimated value of products of Nova Scotia for the year 1901, are also given. The map includes Prince Edward island and the adjacent portion of New Brunswick.

CHARTS.

North Atlantic Ocean and Mediterranean Sea. **Meteorological Office, London.**

Pilot Chart of the North Atlantic and Mediterranean for March, 1903. London: Meteorological Office. *Price* 6*d*. *Presented by the Meteorological Office, London.*

United States Charts. **United States Hydrographic Office.**

Pilot Chart of the North Atlantic Ocean for February, and of the North Pacific Ocean for March, 1903. U.S. Hydrographic Office, Washington, D.C. *Presented by the U.S. Hydrographic Office.*

PHOTOGRAPHS.

Central Asia. **Bruce.**

Forty-two Photographs of Central Asia, taken by Major C. D. Bruce in 1901 and 1902. *Presented by Major C. D. Bruce.*

One of Major Bruce's journeys, during which these photographs were taken, extended from Pekin to Russia, across the desert of Gobi, and another through northern Persia and along the line of the Transcaspian railway. The following are the titles:—

(1) Mounted Mongols dragging Major Bruce's Chinese cart with baggage; (2) Mongolian prayer-wheel; (3) One of Major Bruce's mounts in a Mongol camp with his own saddle; (4) Major Bruce's Chinese cart, taken from Kalgan to Urga for baggage; (5) Crossing the Selenga river between Kiachta and Verchni-Udinsk on a native ferry; (6) The "Living God" of Urga holding a wrestling fête; (7) Major Bruce's tarantan; (8) Mounted Mongols in the desert dragging Major Bruce's Chinese cart; (9) Mounted Mongols near the Kalgan border; (10) Mongol encampment of Arun-Naima in the middle of the desert; (14) A "turn" in the Russo-Persian road over the mountains from Askhabad to Meshed; (15) One of the main gates of Meshed; (16) Stone-cut inscription on a rock between Meshed and Kelat-i-Nadiri; (17) The Argwan Shah gate of Kelat-i-Nadiri; (18) The village of Nhowkhadar in the centre of the Deregez valley; (19) Among the ruins at Bairam-Ali; (20) The tomb of Sultan Sanjur; (21) Bokhara main city gate, native city; (22) Tank in the native city, Bokhara; (23) Some of the Emir's troops; (24) A colonel of the Emir's troops; (25) A street in Samarkand; (26) The court of the Tilah Hari, Samarkand; (27) Separate tombs outside and near the Shah Zindah; (28) Bibi Khanim's tomb, Samarkand; (29) A corner in the horse market, Samarkand; (30) A view of Samarkand; (31) The finest pair, but one, of *Ovis Ammon* horns Major Bruce saw on his journey; (32) A Central Asian common cart, an "arba;" (33) Group of Kirghiz near Aulieta; (34) The interior of a private stud farm; (35) Three Russian officers going on plague duty; (36 and 37) The Russian Archbishop of Turkestan arriving at a post station, Bernuei; (38) A Kirghiz on a cow; (39) Easter week at Kopal: a swing on the "village green;" (40) On the banks of the river Ayaguz, close to Sergiopol; (41) Major Bruce's companion, Captain Chirkarsoff, in a boat; (42) Kirghiz swimming the river; (43) Ferry over the Irtish river at Semipalatinsk; (44) Crossing by the ferry over the Irtish river; (45) A salt-heap near Pavlodar on the Irtish river.

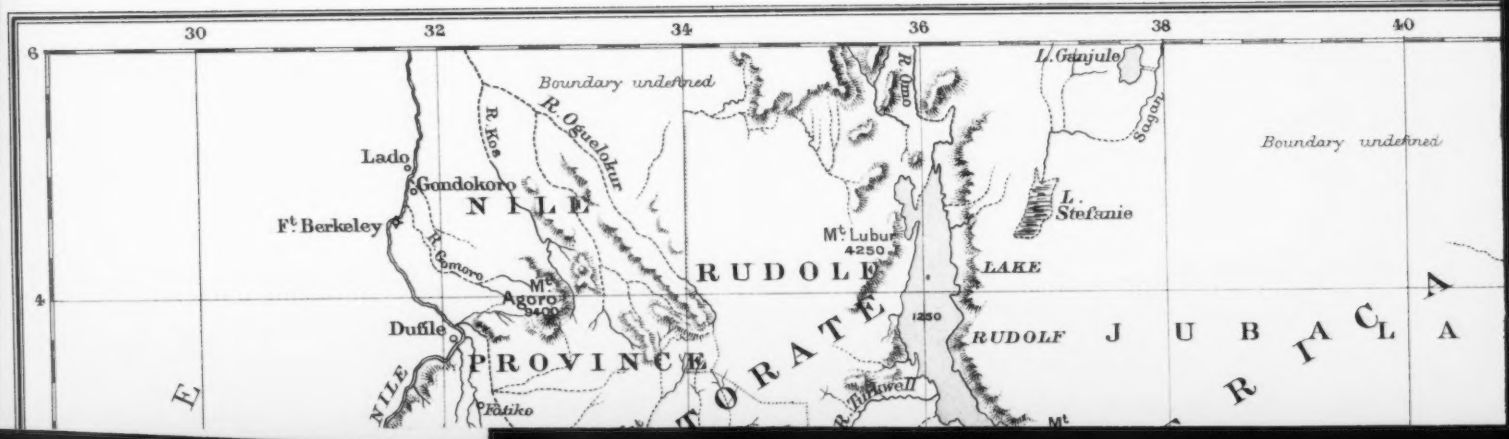
West Indies. **Anderson.**

Eleven Photographs of Martinique and St. Vincent, taken after the eruptions of May, 1902, by Dr. Tempest Anderson. *Presented by Dr. Tempest Anderson.*

These photographs illustrate Dr. Tempest Anderson's paper in the *Geographical Journal* for last month.

(1) Tropical vegetation, Chateau Belair; (2) The Wallibu district from the sea; (3) In the Wallibu valley; (4) Steam and ash explosions, Wallibu; (5) The mouth of the Wallibu from the sea; (6) The site of the Wallibu subsidence; (7) A beach outside the devastated area; (8) Ridges on the Soufrière; (9) Main street of St. Pierre; (10 and 11) Mont Pelée in eruption.

N.B.—It would greatly add to the value of the collection of Photographs which has been established in the Map Room, if all the Fellows of the Society who have taken photographs during their travels, would forward copies of them to the Map Curator, by whom they will be acknowledged. Should the donor have purchased the photographs, it will be useful for reference if the name of the photographer and his address are given.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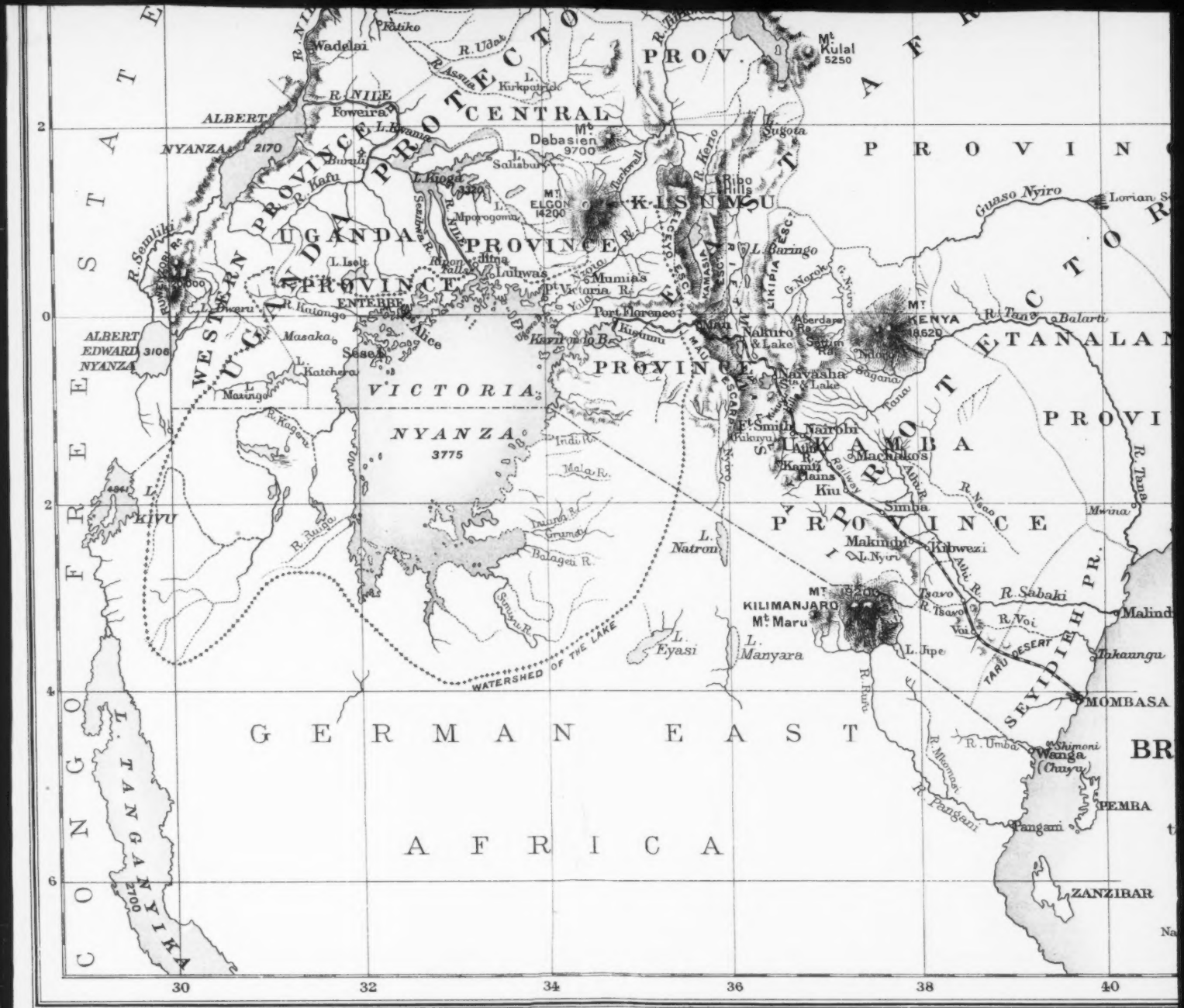
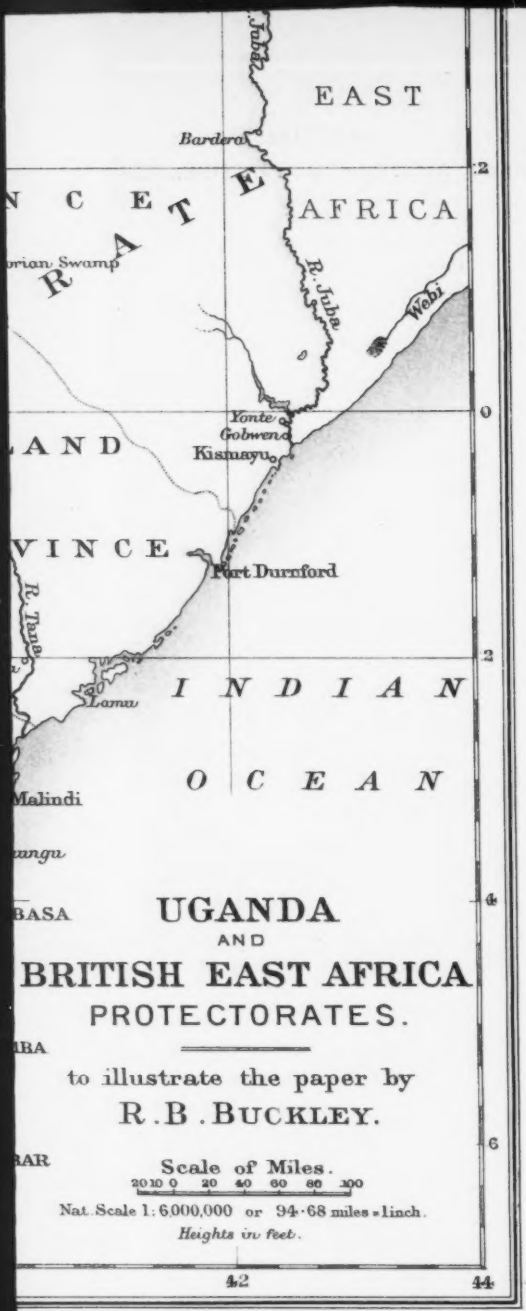


Sansons Sinusoidal Equal Area Projection

Published by the Royal Geographical Society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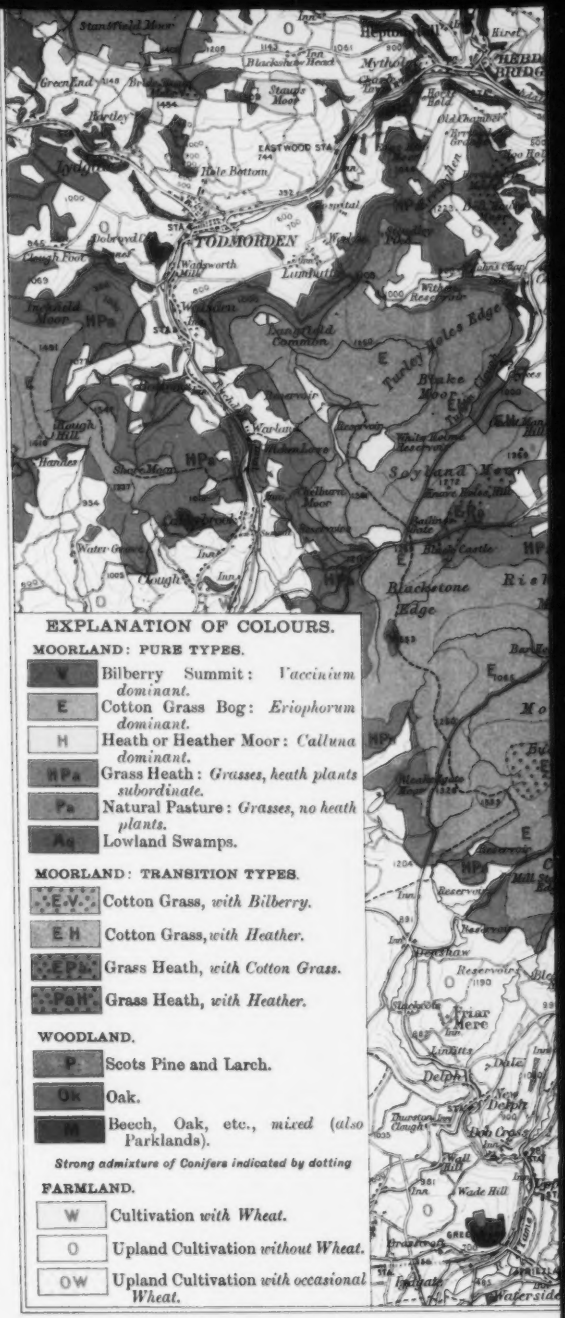
Barderai
R. Juba
Webi
Yonte
Golweni
Kismayu
Port Durnford
R. Tana
Lamu
INDIAN
OCEAN
Malindi
UGANDA
AND
BRITISH EAST AFRICA
PROTECTORATES.
to illustrate the paper by
R. B. BUCKLEY.
Scale of Miles.
20 10 0 20 40 60 80 100
Nat. Scale 1: 6,000,000 or 94·68 miles = 1 inch.
Heights in feet.
42
44

Forest of Trawden
Boulsworth
Widdop Moor
Heptonstall Moor
Crow Hill
Combe Hill
Winewall
Trawden
Wycoller
Wadsworth Moor
Stanfield Moor
Black Moor
Stansfield Moor

GEOGRAPHICAL DISTRIBUTION OF VEGETATION IN YORKSH

LEEDS & HALIFAX DISTRICT. BY WM. G. SMITH & C. E. MOSS.

KSHIRE - PART I.



EXPLANATION OF COLOURS.

MOORLAND: PURE TYPES.

- V — Bilberry Summit: *Vaccinium dominant.*
- E — Cotton Grass Bog: *Eriophorum dominant.*
- H — Heath or Heather Moor: *Calluna dominant.*
- HPa — Grass Heath: *Grasses, heath plants subordinate.*
- Pa — Natural Pasture: *Grasses, no heath plants.*
- Aq — Lowland Swamps.

MOORLAND: TRANSITION TYPES.

- E.V. — Cotton Grass, *with Bilberry.*
- E H — Cotton Grass, *with Heather.*
- EPa — Grass Heath, *with Cotton Grass.*
- PaH — Grass Heath, *with Heather.*

WOODLAND.

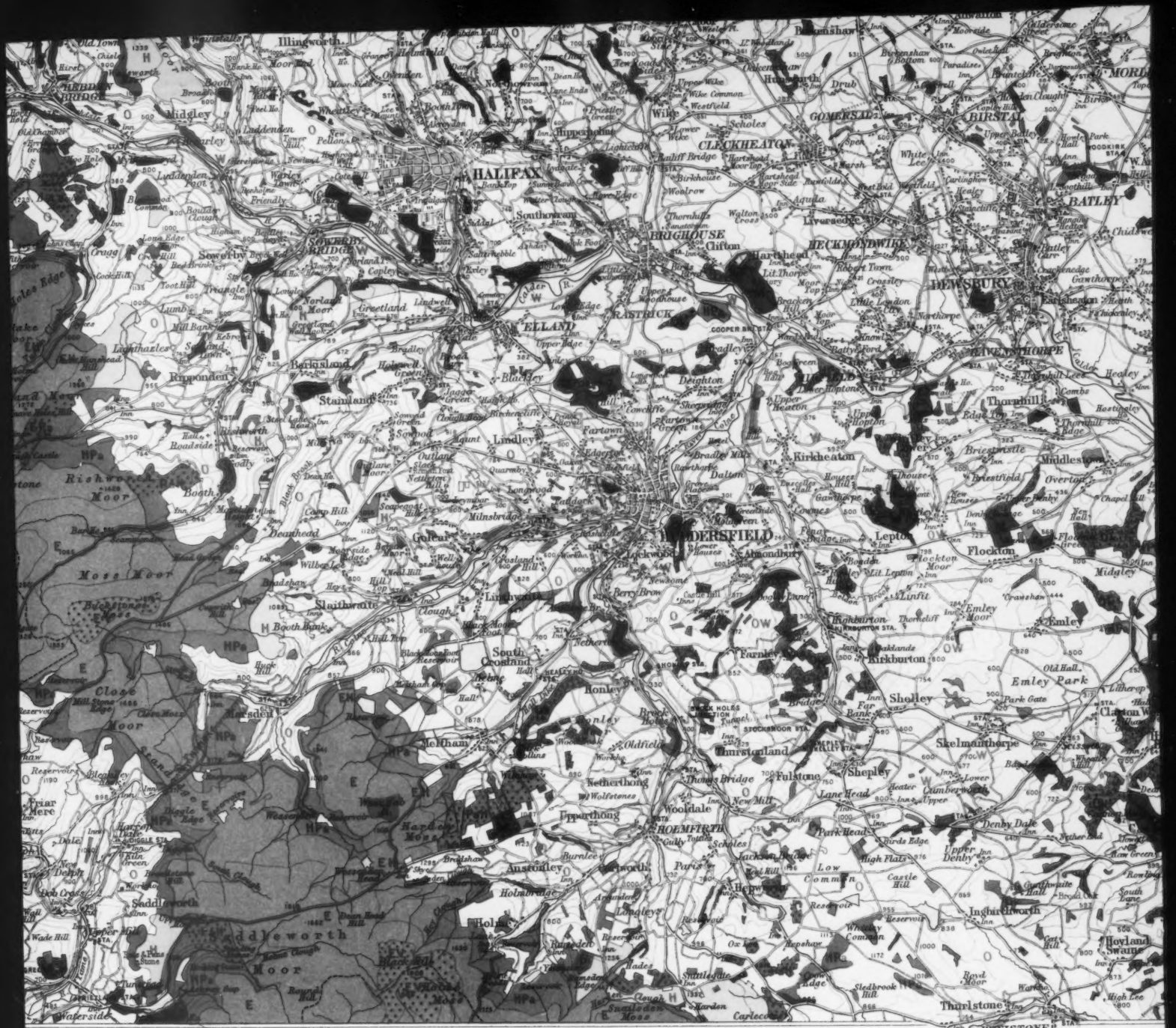
- P — Scots Pine and Larch.
- Ok — Oak.
- M — Beech, Oak, etc., *mixed* (also Parklands).

Strong admixture of Conifers indicated by dotting

FARMLAND.

- W — Cultivation *with Wheat.*
- O — Upland Cultivation *without Wheat.*
- OW — Upland Cultivation *with occasional Wheat.*

The Edinburgh Geographical Institute


HALIFAX
BRIGHOUSE
ELLAND
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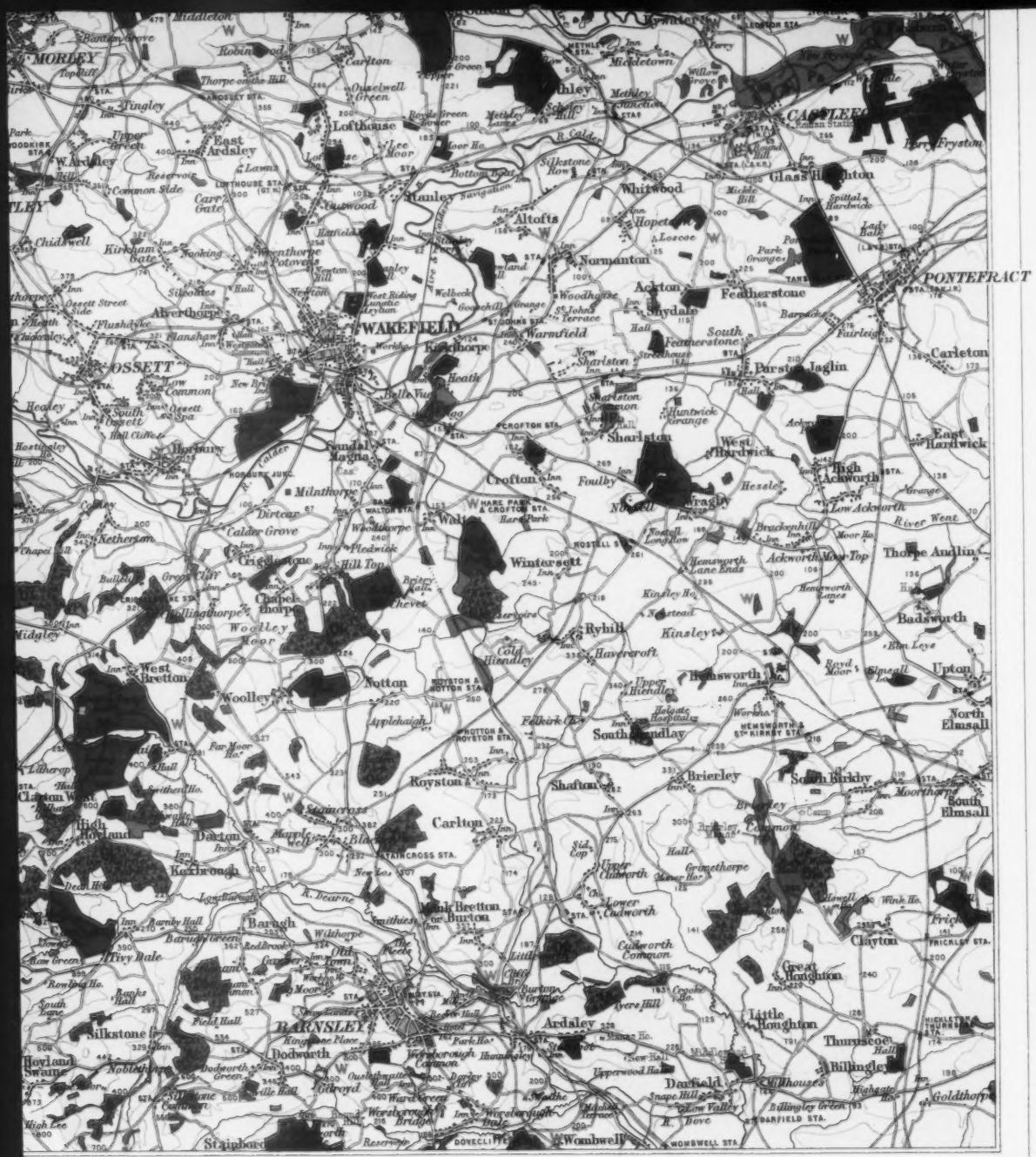
Ripponden
Barkisland
Stainland
Greetland
Lindley
Kirkheaton
Thornhill
Flockton
Emley
Shelley
Skelmanthorpe
Shepley
Fulstone
Thurstonland
Holmfirth
Scholes
Hepworth
Denby Dale
Inghirdenworth
Thurlstone
Penistone
Slaithwaite
Marsden
Meltham
Honley
Lepton
Kirkburton
Earnley
Almondbury
Lockwood
Milnsbridge
Golcar
Scapegoat Hill
Outlane
Deighton
Hartshead
Heckmondwike
Liversedge
Gomersal
Cleckheaton
Birstall
Batley
Dewsbury
Mirfield
Ravensthorpe
Thornhill
Middlestown
Briestfield
Overton
Chickenley
Healey
Eastthorpe
Northorpe
Hartshead Moor Top
Lit Thorpe
Robert Town
Crossley
Little Leeds
Upper Hopton
Upper Heaton
Dalton
Bradley Mills
Bradley
Cooper Bridge
Deighton
Sheepridge
Fartown
Edgerton
Longwood
Paddock
Netherton
Scapegoat Hill
Outlane
Slack
Quarmby
Lindley
Clough House
Birchencliffe
Stainland
Greetland
Lindwell
Holdsworth
Barkisland
Ripponden
Soyland
Triangle
Sowerby
Copley
Luddenden
Luddenden Foot
Warley Town
Friendly
Southowram
Saddleworth
Clifton
Hartshead
Lit Thorpe
Moor Top
Brockley Hill
Little Leeds
Northorpe
Upper Heaton
Upper Hopton
Bradley Mills
Dalton
Kirkheaton
Briestfield
Overton
Middlestown
Thornhill
Thornhill Edge
Thornhill Lees
Combs
Healey
Eastthorpe
Ravensthorpe
Mirfield
Chickenley
Flockton
Flockton Moor
Lepton
Linfit
Emley
Emley Moor
Emley Park
Old Hall
Park Gate
Far Bank
Shelley
Skelmanthorpe
Shepley
Fulstone
Thurstonland
Stocksmoor Sta
Kirkburton
Oaklands
Highburton
Kirkburton Sta
Thorncliff
Earnley
Almondbury
Lockwood
Newsome
Castle Hill
Berry Brow
Milnsbridge
Golcar


WAKEFIELD
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Ryhill
Hemsworth
South Kirkby
Brierley
Shafton
Royston
Carlton
Darton
Barugh
Ardsley
Dodworth
Darfield
Wombwell
Thurnscoe
Great Houghton
Little Houghton
Clayton
Upton
Badsworth
Thorpe Audlin
East Hardwick
Carleton
Whitwood
Castleford
Pontefract
Stainborough
Silkstone
Hoyland Swaine
Notton
Woolley
Crigglestone
Chapelthorpe
Horbury
Alverthorpe
Wrenthorpe
Sandal Magna
Walton
Ackworth
Low Ackworth
High Ackworth
Badsworth
North Elmsall
South Elmsall
Moorthorpe
Billingley
Goldthorpe
Darfield
Ardsley
Barugh
Dodworth
Silkstone
Stainborough
Wombwell
Darfield
Thurnscoe
Billingley
Goldthorpe
Upton
Badsworth
Thorpe Audlin
East Hardwick
Carleton
Pontefract
Castleford
Whitwood
Normanton
Featherstone
Knottingley
Crofton
Sharlston
Wintersett
Ryhill
Hemsworth
South Kirkby
Brierley
Shafton
Royston
Carlton
Darton
Barugh
Ardsley
Dodworth
Darfield
Wombwell
Thurnscoe
Great Houghton
Little Houghton
Clayton